INDIAN CENTRAL JUTE COMMITTEE

Annual Report of the Jute Agricultural Research Institute, (1951-52.)

Calcutta

1953

COMMONWEALTH MYCOLOGICAL INSTITUTE
10 JUN 1953

ANNUAL REPORT OF THE JUTE AGRICULTURAL RESEARCH INSTITUTE, (1951-52)

INTRODUCTION

During the year under report jute and substitute fibre crops occupied 24.5 and 4.5 acres respectively at Chinsurah farm. Of the 24.5 acres under jute, 3.5 acres were for multiplication of seeds of improved strains and 21 acres were under experimental crop.

In view of the shifting of the laboratories and farm from Chinsurah, few crops other than fibre crops, were grown as second crops after the harvest of fibre crops in 1951-52 season at Chinsurah. The acreages under other crops (other than fibre crops) were as follows : Paddy—7 acres ; Gram—0.5 acre ; Khesari—0.5 acre.

The land at Barrackpore taken possession of by the end of January, 1951 was very much encumbered with trees, shrubs and jungles. Considerable amount of spade work had to be done under very trying conditions in clearing jungles and tanks, levelling of land etc., and about 48 acres of land were reclaimed during the year under report. The whole of the reclaimed area was put under multiplication of improved jute strains. A total quantity of 197 maunds 39 seers of seeds of different improved strains was grown and distributed for further multiplication in various jute growing States in their seed multiplication farms and some was retained for experimental work and further multiplication.

SEASON

The season was characterised by very late and inadequate pre-monsoon showers. Consequently, land preparation and sowings were late and crop growth at the early stage was not satisfactory. From the last week of May alternate rain and sunshine helped the progress of sowings and intercultural operations and enabled the crop to pick up and overcome the adverse effects of late sowings. The total rainfall during the season was far short of normal and there had been a scarcity of water for retting.

The data on rainfall and number of rainy days for the year 1948-49, 1949-50, 1950-51 and 1951-52 are given below :

Months	1948-49		1949-50		1950-51		1951-52	
	No. of rainy days	Rain-fall. (Inch)	No. of rainy days.	Rain-fall. (Inch)	No. of rainy days.	Rain-fall. (Inch)	No. of rainy days.	Rain-fall. (Inch)
April ...	5	1·99	11	6·67	2	1·72	2	0·12
May ...	12	5·07	12	17·08	9	2·44	5	1·32
June ...	14	7·20	15	11·02	18	10·32	14	6·10
July ...	22	7 60	25	16·59	26	8·92	20	5·12
August ...	23	12·00	19	7·49	23	10·51	23	9·26
September ...	20	8·42	23	11·75	10	1·56	14	8·65
October ...	4	3·03	13	5·68	12	7·13	11	4·38
November ...	8	4·10	...	...	7	7·14	2	1·65
December ...	...	...	...	...	...	...	...	...
January ...	2	0·16	...	...	...	...	...	...
February ...	1	0·08	2	0·37	...	...	...	...
March ...	1	1·64	3	0.58	6	2·92	5	0·63
Total ...	112	51·29	123	77·23	113	52·66	96	37·23

For land preparation and sowings of jute under Chinsurah conditions the rainfall during the months of April and May are important. Sowings beyond 1st week of June do not generally provide sufficient time for growth of the jute crop resulting in poorer yields. Under Chinsurah conditions a total of 35 to 40 inches of rainfall from April to September spread over a period of about 85 to 95 days seems good enough for jute as far as crop growth is concerned.

DEVELOPMENT OF THE JUTE AGRICULTURAL RESEARCH INSTITUTE

The laboratories of the Jute Agricultural Research Institute was shifted in November-December, 1951 from Hooghly to a rented house at Barrackpore and the farm to our land at Nilganj near Barrackpore. After the shifting, condi-

tions for experimental work did not improve much. Essential farm structures, irrigation facilities and quarters for field staff, etc., have not been provided.

Plans for the Institute building and Class III and Class IV staff quarters have been prepared by the Chief Architect, C.P.W.D., Government of India and approved by the Committee. The construction work has already been entrusted with the C.P.W.D.

I. BREEDING AND GENETICS OF JUTE

1. Collection of Varieties and Types

367 samples of local jute seeds including 129 which could not be studied during the last season due to poor growth and 136 received late last year were sown during this season. The samples were sown at our newly established farm at Barrackpore. Germination was good and growth fair. 600 primary selections were made from promising types for study during the next season. Two samples of *capsularis* and 5 of *olitorius* received after the jute season were preserved for sowing during the next season. 10 samples of seeds, 8 *capsularis* and 2 *olitorius*, from foreign countries were sown during the season. This included 7 *capsularis* types which could not be sown last year due to late receipt. Of the *capsularis* types, 4 were from China, 2 from Brazil and 1 each from Japan and Florida. Of the two *olitorius* types, one was received from Florida, U.S.A. and the other from Philippines.

Among the Chinese types, germination ranged from poor to fair. They are moderately early types flowering in 30-60 days after sowing and growth in 3 of the 4 types was poor. Only one plant germinated from the *capsularis* seed sample supplied from Florida. This was found to be bushy and dwarf and it flowered very late. Germination was poor in the Japanese *capsularis* type and the plants were stunted. This was found to be an early type. The *olitorius* type received from Florida was a normal cultivated green type attaining an average height of 9 feet and flowering in about 90 days after sowing. The *olitorius* sample from the Philippines was observed to be a cultivated type as seen from its seed-coat colour, germi-

nation and performance of the plants. It was a green *olitorius* type mixed with a few red plants. Of the two cultivated *capsularis* types—Salimoes and Lisa received from Brazil—Salimoes resembled Halmahera in its non-branching habit, thick base and stipule character and Lisa, D154 in its general appearance. Though in both the varieties, the onset of flowering is at about the same time, in Salimoes, however, the duration of flowering is prolonged.

5 samples of *C. capsularis* seeds, 2 each from China and Brazil and 1 from Thailand and 2 samples of *C. olitorius* seeds, 1 each from Uganda (Africa) and China were received late and kept for sowing during the next jute season.

Wild species of Corchorus.—14 samples of seeds of different species of *Corchorus* including 1 received from the Philippines were grown during the year. Of these, *2 olitorius* varieties, one from Madhya Pradesh and the other from Bombay were found to be cultivated types. 3 Indian and 1 Philippine samples of *C. olitorius* were found to be wild. One type from Bombay turned out to be a mixture of cultivated and wild *olitorius*. One *C. capsularis* type, apparently wild, was recorded in a collection from Hooghly district of West Bengal. The leaves of this are non-bitter and the type was reported to be grown as a pot-herb in the kitchen garden in Midnapore district, from where it was brought to Hooghly. One type from Hyderabad was found to be *C. trilocularis*. A type from Junagadh (Saurashtra), while resembling *C. trilocularis* in general habit of the plant and pod character differed from it in its leaf shape, seed size and seed coat colour. Two samples from the same source were identified as *C. acutangulus*. The other 2 samples, also from Junagadh failed to germinate.

The wild form of *C. capsularis* from Bombay was grown in a small broadcast plot which was harvested for fibre. The yield of fibre calculated from this plot was only 6.2 maunds per acre. The fibre was sent to the Technological Research Laboratories for quality tests. A thorough evaluation of the possibilities of this wild type will be made during the next season, when it is proposed to include it in a yield trial.

In all 30 selections were made from the wild species of *Corchorus*.

2. BREEDING OF JUTE

During the year 7 breeding trials, 6 *capsularis* and 1 *olitorius* were conducted with promising materials carried forward from the crop of the previous year. 2 first year trials, 1 each of second and third year trials and 3 multiple crossing trials were planned and sown. Germination in all the trials was good except in the *olitorius* trial where it was fair. 5406 secondary selections were made from the *capsularis* and *olitorius* breeding trials. Pigmentation, height, base diameter, branching habit, date of first flowering, etc., of individual selections were recorded. The seeds of all the selected plants were collected separately, weighed, dried and preserved for further study.

First year test of selections—(*i*) *Capsularis*.—47 selections from the first year trials, which failed during the previous season due to unfavourable weather, along with 2 controls were tried out in an incomplete block layout with 4 replications. Germination was good and the growth of the crop fair. The crop was harvested and the resulting fibre weighed. 784 secondary selections were made in the trial for further studies. The yield data of the trial were analysed. The fibre yield of the materials, as compared to the control, however, proved insignificant. Hence, selections from this trial were not carried forward for further studies.

(*ii*) *Olitorius*.— Selections from the *olitorius* first year trial of the previous year which suffered from the effects of drought, along with the primary selections made last year were tried out in an incomplete block layout with 4 replications during the year. 47 selections were included in the trial. Due to the absence of rain after sowing, the seeds germinated in two instalments and the germination ranged from good to poor. The trial was, however, harvested for fibre. A total number of 784 secondary selections were made in the trial. The yield data were analysed. 6 promising cultures from the experiment were carried forward for further studies.

Second year test of selections—Capsularis.—One second year trial which was planned and sown in 1950 but the full performance of which could not be ascertained that year due to extremely poor germination was repeated during the year under report. 10 families with 6 progenies each were tested in a compact family block layout. Germination in all the progeny plots was good and the growth of the crop fair. The materials were studied and 1116 secondary selections made from the cultures. The yield data were analysed. However, none of the families proved significantly superior to the control and the trial was rejected.

There was no *olitorius* material in the second year stage.

Third year test of selections.—A third year trial was planned with 3 families from C48-795 and 2 families from C48-850 carried forward from the second year trials of the previous year. 5 families of the third year trial, the full performance of which could not be ascertained during 1950 were also included for studies in the same trial. Thus 10 families with 6 progenies each were tried out in a compact family block layout. Germination and growth of the crop were good. The trial was harvested for fibre and the results were analysed. A total number of 1116 selections were made from all the cultures in this trial. Two families which were statistically as good as control but yielded slightly better were carried forward for further studies during the next season.

There was no *olitorius* material at the third year stage.

Test of selections in multiple crossing materials—Multiple crossing first year trial.—A first year trial was conducted with 20 selections from promising multiple crossing materials which could not be included in trials earlier due to limited seed. Germination was good and the growth of the crop fair. 396 secondary selections were made in the experiment for further study. On analysis of the yield data none of the cultures proved superior to control and the materials were rejected.

Multiple crossing trials.—12 families of multiple crossing materials with 5 progenies each were tested in 2 compact family block trials. Germination in the trials ranged from good to fair. 1952 secondary selections were made from all the cultur-

es. The trials were harvested for fibre and the yield data analysed. Only 4 progenies from 2 families which were statistically as good as control were carried forward.

Besides the above, 16 selections not included in trials were multiplied and 58 secondary selections made from them.

Varietal trials—Capsularis.—2 varietal trials were sown with the promising strains evolved by the Institute. The first trial that included the more important materials was in the nature of a serial experiment and was a repetition of the previour year's trial. Due to late rains the experiment could not be sown earlier than 25.5.51. The germination, growth and final stand in all the plots of the experiment were good. The trial was harvested and the fibre samples of all the varieties were sent to the Technological Research Laboratories for quality tests. The yield data and the quality ratios are given in Table I.

TABLE I

Capsularis Varietal Trial No. 1

Date of sowing—25-5-51. Harvested between 13-9-51 and 4-10-51 at the small pod stage.

Layout—Randomized blocks in 6 replications. Gross plot size—1/60 acre (29′ × 25′). Effective plot size—1/83 acre (25′ × 21′).

Variety.	Yield per acre in Mds.	Percent on control.	Date of first flower.	Quality ratio.
C39-212 ...	29·85	124·17	21-8-51	104±1·4
C41-13 ...	27·01	112·35	27-8-51	102±1·5
Orissa 6J ...	24·63	102·45	18-8-51	92±1·4
JR48-1 ...	24·48	101·83	31-8-51	91±1·4
Jap Rd ...	24·11	100·29	4-9-51	107±1·4
D154 ...	24·04	100·00	1-9-51	91±1·4
Fanduk ...	21·82	90·77	13-8-51	103±1·0
C42-Kj-321 ...	20·56	85·52	17-8-51	104±1·4
P ...	0·01	...	...	...
Critical difference ...	2·393	...	...	...
Standard error %	2·534	...	...	...

It may be seen from the table above that C39-212 and C41-13 are significantly superior to the control D154 yielding about 24% and 12% respectively higher. C39-212 which ranked best is also significantly superior to C41-13. Orissa 6J, JR48-1 and Jap Rd all of which yielded slightly better than control, but were found to be statistically as good.

Jap Rd with a quality ratio of 107 as compared to 91 of D154 maintained its superiority in quality this year also. Both C39-212 and C42-Kj-321 with a quality ratio of 104 ranked next. Fanduk and C41-13 with quality ratios of 103 and 102 followed closely. Based on the data given above, it may be stated that C39-212 is a highly desirable *capsularis* strain.

The second *capsularis* trial with 8 varieties, *viz.*, D386, C42-Kj-320, C42-Kj-322, C42-Nj-412, Assam 16, Kamardani, Hewti and Halmahera and 2 controls was sown on the 5th June, 1951. Germination was found to be satisfactory in all the plots. The materials were harvested at the small pod stage between 14th September, 1951 and 24th September, 1951. Fibre samples from the trial were sent to the Technological Research Laboratories for quality tests.

The yield data from the trial were analysed. It was found that no material was statistically better than control D154. D386 which yielded slightly higher was in the same group with control.

Olitorius.—The *olitorius* varietal trial with three improved strains evolved by the Institute along with R26 and C. G. was repeated during the year. The trial was sown on the 28th May 1951. Germination was good in all the plots and the growth of the crop was satisfactory. The trial was harvested and fibre samples from all the varieties were sent to the Technological Research Laboratories for quality tests. The yield and quality figures are given in Table II :

TABLE II

Olitorius Varietal Trial

Date of sowing—28.5.51. Harvested between 5.10.51 and 6.10.51 Layout—5 × 5 Latin square. Gross plot size—1/50 acre. (35′ × 25′) Effective plot size—1/67 acre (31′ × 21′)

Variety	Yield per acre in maunds	Percent on control	Date of first flowering	Quality Ratio
O40—753 ...	26·09	139·03	30·8·51	74±1·5
O40—632 ...	25·69	136·88	27·8·51	79±1·7
O39—620 ...	23·86	127·16	7·8 51	89±1·3
C. G. ...	18·76	100·00	5·8·51	80±1·3
R26 ...	17·80	94·85	15·8·51	89±2·3
P ...	0·01			
Critical difference	2·17			
S. E.% ...	2·24			

It may be seen from the above that all the three improved strains, evolved by the Jute Agricultural Research Institute, *viz.*, O40-753, O40-632 and O39-620 proved significantly superior to the control C. G. in yield by about 39, 37 and 27%. respectively. O40-753 and O40-632 were both statistically as good, the former proving significantly superior in yield to O39-620.

O39-620 gave a quality ratio of 89 as compared to 80 of control C. G. and thus maintained its superiority in quality ratio. O40-753 and O40-632 were slightly inferior to C. G. in quality of fibre.

Polyploidy and interpecific hybridization.—1948 colchicine-treated series.—Seeds of 40 capsules from 8 *capsularis* plants obtained from the polyploid generation (C_3) of the 1948 treated series showing morphological characters of polyploidy were sown separately capsule-wise in lines. Germination was

very poor. Seeds from only 13 capsules germinated giving a total population of only 20 plants. The progenies maintained the distinctive morphological features characteristic of polyploids. Seeds from these have been collected at the rate of 5 capsules from each plant besides bulk seed of the rest of the capsules wherever possible. It may be of interest to point out that 3 of the progenies produced less than 5 capsules each and bulk seed could be obtained only from 17 plants.

Bulk seeds could be obtained from only 7 of the 8 plants of the 1948 colchicine-treated series (C_3) in 1950. Only 33 plants were obtained from these seeds, of which only 24 survived and set seeds. Seeds of the progenies of each parental plant of 1950 were bulked up and has been used for studies in 1952-53 season.

1950-colchicine-treated series—Capsularis.—Of the 161 capsules from 27 plants of 1950, only 3 capsules from 3 different plants gave polyploid progenies. These 3 plants were all from 0.0125% concentration of colchicine and 6, 12 and 18 hours treatments. 11 plants were obtained, 3 from 6 hours, 7 from 12 hours and 1 from 18 hours treatments. All of them showed the morphological features characteristic of polyploids and did not differ from those obtained from 1948 treated series. Seeds from all the progenies, both pod-wise and bulk have been collected for further studies.

Olitorius.—248 pods from 20 *olitorius* plants exhibiting polyploid appearance in 1950 were sown in lines during the year. Germination in all the lines was fair. Progenies of only 4 plants were tetraploids and these exhibited all the characters distinctive of *olitorius* tetraploids ($2n=28$). They have large, roundish leaves with larger stomata and they tend to branch more. They begin to flower at about the same time as normal plants, but the period of flowering is prolonged. The flowers, floral parts, pollen grains, etc., are larger. The fruits are short and stumpy and contain a large proportion of non-viable seeds.

The plants in general reach only about 2/3rd of the height attained by normal plants but the base diameter is

comparatively more. Single pod and bulk seeds of selected polyploid plants have been retained for further studies.

Vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute.—12 selections from interspecific grafts made in 1949 which could not be studied in 1950 due to poor growth, were grown during the year. Germination ranged from good to poor. But the growth was unsatisfactory and the materials had to be rejected.

Of the 20 grafts made during last year, seeds from stocks and scions of 6 plants were grown. Germination was fair. 15 second generation grafts were made adopting inarch, cleft and splice methods of grafting. 8 of these yielded seeds from both stock and scion. The seeds have been preserved for sowing next year.

3. Inheritance of Character

Genetic strains.—63 cultures including 51 true breeding materials of the previous year along with 12 materials which were brought forward from the purification series were grown during the year for confirmation and maintenance. Individual progenies of cultures representing such characters as pigmentation patterns, branching habit, leaf shape and size including the shape of the leaf margin, taste of the leaf—whether bitter or non-bitter, stipule character, date of flowering, corolla colour and shape, anther colour, pod size and shape, seed coat colour were studied with a view to ascertain whether the materials were segregating for any of these characters. 55 cultures were found to be breeding true to the parental characters. 311 selections covering all the materials were made during the study.

7 selections of 1950 were grown in a purification series during the year. The performance of their progenies was studied. 5 of these cultures did not segregate. In all 24 selections have been made among the materials for further study and confirmation during the next year.

Besides the above, interesting materials from general trials, cultivators' plots and foreign materials accounted for 18

selections which will be included in the purification series for intensive studies next year.

This work will be continued and a comprehensive series of established genetic strains will be built up and fresh materials will be added to the collection as new characters are confirmed and fixed.

Isolation of full green genotype.—90 test crosses made during 1950 along with 60 selections of parents were sown in lines during the year for confirmation of the genotype of full green parents. As a result, the genotypic constitutions of 12 full green materials from various sources were confirmed. Of these, 4 new full green genotypes having the following constitutions were isolated and added to our collection.

$ccA^{R}A^{R}RR$
$ccA^{L}A^{L}rr$
$ccA^{R}A^{R}rr$
$ccA^{D}A^{D}rr$

It may be mentioned here that A^{D} is the fifth member of the allelomorphic series, $A\text{-}A\text{-}A^{L}\text{-}A^{R}\text{-}A^{D}$, which has lately been identified. This brings the total number of full-green genotypes isolated so far to 6 including ccAARR and ccAArr that were already in our stock.

Routine test crosses were made during the year to confirm the purity of all the full green parents carried forward. Fresh crosses were also made during the year to isolate the remaining full green genotypes. Crosses and parents were carried forward for study during the next season.

Anthocyanin pigmentation.—The F_2s of crosses between the dark-red and all the other types of pigmentation under the three pigmented groups were grown along with the back-crosses and the parents. Four F_2 families for each type of cross were grown and classified.

The F_2s of crosses between dark-red and full green (2) type, i.e. full green without the reducer gene, segregated into dark-red, coppery red and full green types in the digenic ratio of 9:3:4.

The F_2s of crosses between dark-red and green-coppery-red segregated into green-dark-red, dark-red, green-coppery-red and coppery-red in the digenic ratio of 9:3:3:1. It may be mentioned here that green-dark-red is a new synthetic pigmented member of the green-pigmented series recorded during the study. In a cross between dark-red and green-red, the F_2s segregated into green-dark-red, green-red, dark-red and red phenotypes in the same proportion.

The F_2s of crosses between deep-red and members of the red group segregated into the two parental types only in the monogenic ratio of 3 : 1. All the back-crosses made in 1950 were studied and classified. The segregations in the back-crosses were as expected and confirmed the genotypic constitution of the dark-red parent. As a result of this study 2 new pigmentation types having the constitutions CCA^DA^Drr and CCA^DA^D RR were confirmed.

Crosses made during the previous year for the study of the mode of inheritance of anthocyanin pigmentation in foreign types and their behaviour when crossed with Indian types were grown during the year. 110 crosses between Indian and foreign *capsularis* jute and 30 crosses between different foreign *capsularis* jute were sown. The F_1s were studied and back-crosses with both the parents made in all the combinations. 385 successful back-crosses have been obtained for further studies during next year. 40 fresh crosses between Indian and foreign *capsularis* and 14 fresh crosses between foreign *capsularis* types were obtained covering some of the missing combinations.

Seeds from at least 5 F_1 selections for each combination and all the back-crosses have been carried forward.

Extra-axillary branching habit.—13 F_2 families and 17 back-crosses were grown along with the parents and studied. Germination in the back-crosses was poor though in the F_2s adequate population was obtained. The F_2s were classified for the normal and extra-axillary branching habit. The position of the extra-axillary branch varied from just above the axil of the leaf to any point between the two nodes, often on the side of the stem opposite the leaf.

The axillary branching habit of Indian jutes was found to be dominant over the extra-axillary branching habit of the foreign types and controlled by a single factor pair.

Repand (Wavy) leaf type.—12 back-crosses, 5 F_2 families and parents of the crosses were grown during the year for further studies. The F_2 families segregated into wavy and normal plants in the monogenic ratio of 3 : 1.

The back-crosses made with the recessive parent (Normal) segregated into wavy and normal in the ratio of 1 : 1 as expected.

Leaf variant.—8 back-crosses and 8 F_2 families carried forward from the previous year were grown. The germination in the back-crosses was poor. The F_2 families were classified into normal and variant phenotypes.

Besides the F_2 families, 10 normal segregates from culture C48-8565-2444 and 2 from C48-8565-2450 were also grown. 7 families of the former and both the families of the latter segregated giving normal and variant plants.

The F_2 families of the crosses between non-branching normal plants and branching variant gave non-branching variants besides normal branching variants.

Further studies are in progress.

Chlorosis.—22 chlorotic selections, 20 *capsularis* and 2 *olitorius*, showing different degrees of chlorosis were grown. Germination was good to fair. The progenies of all the selections produced both non-chlorotic and chlorotic individuals, the percentage of the latter being very small. The patterns of chlorosis as shown on the leaves of the chlorotic progenies were noted and classified. Selections were also made from both *capsularis* and *olitorius* plants showing chlorosis for further study.

Crosses made in 1950 between chlorotic and non-chlorotic plants were sown along with their parents. The F_1s were all non-chlorotic but the chlorotic parents were found to segregate into both chlorotic and non-chlorotic progenies. As the chlorotic parents were found to be heterozygous, the F_1s were rejected.

Seed-coat colour.—To study the inheritance of seed-coat colour in *C. olitorius* types including the improved strains, 76 crosses were made during the year involving varieties with different seed-coat colours. 43 successful crosses were obtained. The crosses and parents were carried forward.

4. Subvention Trials in Cultivators' Plots

85 subvention trials were planned in 1951-52 in the four jute growing States as under :—

State	*Capsularis*	*Olitorius*	*Total*
West Bengal	11	19	30
Bihar	10	10	20
Assam	14	6	20
Orissa	9	6	15
Total	44	41	85

4 of the trials were not sown. 18 of the trials failed due to adverse seasonal factors like drought, heavy rain and flood and 25 trials were rejected for mistakes in layout and sowing, defective site selection, negligence of the cultivators etc. Final reports were received from 36 successful trials. Results of analysis of the yield data are given overleaf :

STATE	Cap./Oli.	No. of successful trials	Variety	Yield per acre (mds)	% on control
W. Bengal	*Capsularis*	4	C39-212	16·32	107·13
			Local	15·28	100·00
			C41-13	15·03	98·36
			C42-Kj-321	14·48	94·76
			P ...	Large	
			S.E.%	4·87	
W. Bengal	*Olitorius*	10	O40-632	21·35	122·35
			O40-753	21·29	122·01
			O39-620	18·36	105·21
			Local	17·45	100·00
			P ...	0·01	
			C.D. ...	3·30	
			S.E% ...	4·46	
Orissa ...	*Capsularis*	6	C39-212 ...	16·56	116·70
			C41-13 ...	15·33	108·03
			C42-Kj 321	14·52	102·33
			Local	14·19	100·00
			P ...	Large	
			S.E % ...	5·85	
	Olitorius	1	Data inadequate for statistical analysis.		
Bihar ...	*Capsularis*	4	C42-Kj-321	14·10	125·44
			C39-212	13·36	118·86
			C41-13 ...	12·52	111·39
			Local ...	11·24	100·00
			P ...	Large	
			S.E.% ...	7·36	
	Olitorius	3	O40-753	17·66	133·29
			O39-620	13·48	102·28
			Local	13·18	100·00
			O40-632	12·93	98·10
			P ...	0·05	
			C.D. ...	3·21	
			S.E.% ...	7·46	
Assam ...	*Capsularis*	5	C39-212	14·93	109·38
			C42-Kj-321	14·45	105·86
			Local	13·65	100·00
			C41-13	12·25	89·74
			P ...	0·05	
			C.D ...	1·92	
			S.E.% ...	4·72	
	Olitorius	3	O40-753	20·72	124·15
			O40-632	20·15	120·73
			O39-620	19·48	116·72
			Local	16·69	100·00
			P ...	Large	
			S.E % ...	6·55	

Efforts were made to combine the data for the 3 years 1949-50, 1950-51 and 1951-52 from all the States for statistical analysis and estimate the overall performance of the improved strains. But very few trials were successful during 1949-50. Though more trials were successful in 1950-51, the data were considered to be inadequate, especially as Assam, one of the major jute growing States, did not have a single successful trial. Hence, combined analysis had to be restricted to the trials of 1951-52. The results of the combined analysis are given below : —

SUBVENTION TRIALS 1951-52

(Combined analysis).

	No. of trials	Variety	Yield per acre (mds.)	Percent on control
Capsularis ...	19	C39-212	15·42	112·88
		C42-Kj-321	14·40	105·42
		C41-13	13·87	101·54
		Local	13·66	100·00
		P ...	0·05	
		C. D. ...	1·17	
		S. E.% ...	2.91	
		C39-212 is significantly superior to the Local varieties by about 13% in yield.		
Olitorius ...	17	O40-753	20·66	125·98
		O40-632	19·40	118·29
		O39-620	17·77	108·35
		Local	16·40	100·00
		P ...	0·01	
		C. D. ...	2·27	
		S. E.% ...	3·29	
		O40-753 and O40-632 are significantly superior to the Local varieties by about 26 and 18% respectively.		

All the results of quality tests of the 1951-52 trials and also of some of the trials conducted during the previous years are not yet at hand.

Of the *capsularis* improved strains C39-212 proved to be the best in a combined analysis of the yield data obtained in 1951-52 from all the States concerned. This corroborates the results of the varietal trials conducted during 1951-52 at Chinsurah (vide Table I). It also has a high quality ratio and has been found to be comparatively more resistant to stem-rot.

Of the olitorius improved strains, both O40-753 and O40-632 are the best strains. This corroborates the results of the varietal trials conducted at Chinsurah during the years 1950-51 and 1951-52; on an average O40-753 and O40-632 have yielded 33 and 34% higher than C. G. in the varietal trials.

II. ANATOMICAL STUDIES

Developmental anatomy of axillary buds.—The study of the anatomy of axillary buds was completed in some branching and non-branching types. The development of axillary buds in *Corchorus siliquosus*, a natural polyploid has been carried out. The origin and the development of buds has been found to be the same as in *Corchorus capsularis* (D154). Further work is in progress.

Structure and quality of fibre in jute.—It was reported previously that the quality ratio increases with the increase in number of ultimate fibres in each fibre strand. The number of ultimate fibres in each strand was recorded at five different stages of development of two weeks interval in six varieties of *C. capsularis*. In plants harvested after two months, the number of the fibres per strand are more (varying from 24 to 26) than in later stages (14 to 15). This decrease is likely to be due to splitting of the fibre strands with the development of more of secondary rays. When the quality ratio depends upon the number of ultimate fibres in a strand along with other characters like chemical composition, the above observations offer a scope for finding out the influence of the number of ultimate fibres in a bundle on tensile strength of fibres.

Study of fibre layers and secondary xylem vessels in relation to plant height and base diameter.—Selection of high yielding strains is carried on the basis of morphological characters like plant height and base diameter. This study is taken up to explore some anatomical features which are likely to bear relation to the yield. Plants of jap red (*Capsularis*) between 8′ and 9.5′ in height are selected and were divided into three height classes as shown in Table III. Each height class is further sub-divided into three base diameter classes. Each plant is cut into three equal portions and a piece from each portion is fixed in formalin-acetic-alcohol to study the number of fibre layers and vessel diameter in transverse section.

TABLE III

(Number of fibre layers)

Height	8′-1″ to 8′-3″			8′-5″ to 8′-10″			9′-3″ to 9′-5″		
	Base dia. in cm.			Base dia. in cm.			Base dia. in cm.		
	1.1-1.2	1.4-1.5	1.7-1.8	1.4-1.5	1.7-1 8	2.0-2.1	1.7-1.8	2.0-2.1	2.3-2.4
Bot ...	9-10	9-10	13-14	9-11	14-15	14-16	13-14	14	12-14
Mid ...	5-6	6-7	8	5-6	7-8	7-8	7	9-10	9
Top ...	3-4	4	5	4	4-5	6	4	6	4-5

The above data show that in the two height classes, the number of layers increase steadily with the increase of base diameter. For the same base diameter class common to the three height classes, *viz.*, 1.7 cm to 1.8 cm, there is practically no increase of layers with the increase of height. But it can be assumed that the number of layers being constant, the yield of fibre will be more in plants of greater height for that extra portion of the plant. Thus the formation of fibre layers seem to be related more to the base diameter than to the plant height. These results are in agreement with results obtained previously with retted fibre. Fibre formation in extreme classes of plant height and base diameter is yet to be investigated.

In the bottom region, the maximum secondary vessel diameter increases with two exceptions with base diameter and plant height. In the middle and top portions, though

such corresponding increase of vessel diameter with base diameter and plant height is not clear, high values always occur in plants with greater height and base diameter (Table IV), thus indicating a possible relationship between vessel diameter and vigour of the plant.

TABLE IV

(*Diameter of the secondary xylem vessels*)

Height	8'-1"	to	8'-3"	8'-8"	to	8'-10"	9'-3"	to	9'-5"
Base diameter in cm	1.1 to 1.2	1.4 to 1.5	1.7 to 1.8	1.4 to 1.5	1.7. to 1.8	2.0 to 1·2	1.7. to 1.8	2.0 to 2.1	2.3 to 2.4
	microns.	microns.	microns.	microns.	microns.	microns.	microns.	microns.	microns.
Bot ...	59	60	68	65	66	56	72	64	73
Mid ...	72″	68″	72″	68″	72″	77″	76″	73″	76″
Top ...	69″	68″	66″	71″	72″	67″	71″	78″	73″

Study of secondary xylem vessels in relation to yield of fibre.—Previous reports on the hybrid maize indicate a relationship of conducting elements with vigour of plants. The number of vascular bundles and the diameter of bundles are found to be significantly greater than in the inbreds. Metaxylem vessel diameter in the hybrids is greater than in the parents. A study is taken up to see whether the diameter of the secondary xylem vessels in transverse section can be correlated to the yield in jute. Data were taken in 6 varieties of *C. capsularis* at five different stages of development.

Plants harvested after two months after sowing have vessels wider than at later stages. This decrease in width in later stages may be due to pressure by the newly added xylem vessels towards the centre. No relationship could be established between maximum secondary vessels diameter and the yield of the varieties. This may be due to the following reasons. Plants were selected at random but not of the same base diameter and plant height. From the study of diameter of vessels in plants with known base diameter and plant height, it is known that the vessel diameter is influenced by the base

diameter and plant height. Secondly it is very difficult to distinguish small vessels from the wood parenchyma and fibres and errors are likely to creep in from that source.

Routine identification of fibre samples.—Fibre samples were received from Director of Agriculture, West Bengal, Customs Office, Calcutta and Directorate of Economics and Statistics and also from some commercial firms for identification and other information. Fibre samples were also received from individuals interested in substitutes. The required informations were furnished after examination of the samples.

III. CYTOGENETICAL INVESTIGATIONS

Incompatibility between C. capsularis & C. olitorius.— Interspecific hybridization in the cultivated species of jute has been attempted since the days of Finlow and these have resulted in failure. In view of this hurdle breeders have restricted themselves to a selection of strains within the two species. The limitations of this practice have been recognised and there can be no real improvement in this important fibre crop until the incompatibility between the two cultivated species is bridged. Attempts were made by Cytogeneticists working in the Calcutta University (Bhaduri *et al*) and they concluded that it was impossible to overcome this difficulty in the diploid species. Their investigations led them to believe that the incompatibility was due to failure of germination of pollen of one species on the stigma of the other and *vice versa*. They sought to overcome the incompatibility by raising a tetraploid line by colchicine treatment.

Considering the importance of this problem, an attempt was made to examine if at all the incompatibility was due to sterility factors in the stigma and the style as is the classical case in *Nicotiana*. Reciprocal crosses were made between *C. capsularis* and *C. olitorius* by controlled pollination. Care was taken to prevent self-pollination by emasculating selected flowers twenty-four hours before pollination was due to be made. As a result of careful study it was found that the stigmas of both species were receptive between the hours of 9 and 10 in the morning. Pollinations were made during this

hour and the pistils were fixed at ten minute intervals in three parts of absolute alcohol and one part of glacial acetic acid. They were subsequently squashed and stained in acid fuchsin. For the sake of comparison both self- and cross-pollinations were made. Two important conclusions have emerged and they are (1) that in cross matings the pollen grains germinate on the stigma and grow along the style with facility, and (2) that there is no perceptible difference between the rate of growth and other features between the compatible and incompatible pollen tubes. It is now established beyond doubt that the incompatibility reaction does not operate in the stigma and the style. The progress of the pollen tubes have now been traced up to the base of the style and their behaviour inside the ovary will be taken up for study during the ensuing season.

Comparative studies on the rate of growth of the pollen tubes of C. capsularis and C. olitorius in vitro and their cytological studies.—Measurements were taken at different intervals of the length of the pollen tubes. Temperature and humidity were noted in each case. The maximum length of the pollen tube in *C. olitorius* is recorded as 901 μ. The average pollen tube length in *olitorius* is calculated to be 234.68 μ. The maximum length in *C. capsularis* is recorded as 561 μ.

In both the species the pollen grains with branched tubes and two tubes per grain have been observed. The interesting observations are new in jute. In one *capsularis* pollen grain two long tubes were observed, one measuring 119 μ and the other measuring 85 μ. Usually, wherever two tubes are observed, they are found to be small in length.

The vegetative nucleus usually comes out first and is observed at the distal end of the tube and takes very little stain but it also frequently lies considerably behind the generative cell or the male gametes, if already formed.

Study of the pollen grains.—Pollen grains of jute contain abundant starch. The number of nuclei at the shedding condition cannot be determined due to them. Prof. Tiwary's special method of staining pollen grains with acetocarmine

with a pre-treatment of conc. NaOH followed by glacial acetic acid proved a failure. Kodani's mixture (equal parts of saturated aqueous solution of urea and normal NaOH) was added on the pollen grains, then gently warmed and then sufficient acetocarmine in glycerine was added to see the nuclei of the pollen grains in the shedding condition but this method turned out to be a failure in case of jute pollen. The exine is thick and resistant. Pollen grains smeared on the slides were fixed in acetic alcohol (1 : 1) and then kept in conc. HCl. overnight. The exine did not burst out and no inner structure could be seen after staining.

Study of chromosomes in Corchorus species.—Little is known about the details of the cytology of *Corchorus* species. The only facts known so far are that the species of *Corchorus* have the same diploid chromosome number ($2n = 14$) and that in the two cultivated species, *C. capsularis* and *C. olitorius* pairing is normal resulting in the formation of seven bivalents.

In the course of the year meiosis was studied in the following species : *C. capsularis*, *C. olitorius*, *C. trilocularis*, *C. fasciculatis*, *C. siliquosus*.

In the diploid species the behaviour of the chromosomes is normal and as reported by earlier investigators seven bivalents are formed. Our investigations, however, have shown that there is a degree of meiotic lability which is reflected in the appearance of hyper and hypoploid cells with more or less than seven bivalents. These apparently have arisen due to errors in the pre-meiotic divisions, or irregular disjunction at metaphase.

All the diploid species show evidence that the haploid number seven, is secondary and that it is derived from a smaller basic number in the course of evolution of the genus. In all the diploid species we have recorded cases of pollen mother-cells with two bivalents in association with the nucleolus. On the basis of the accepted doctrines that each haploid complement is associated with a single nucleolus, it is clear that the apparently diploid species are secondary polyploids. This view is strengthened by the other observation

that in the diploid types examined the bivalents at first metaphase tend to remain in groups. This part of the work will be continued during the next season.

C. fasciculatis also shows seven bivalents at first metaphase. But many interesting phenomena such as the free occurrence of polyploid cells among the normal diploid pollen mother cells, and amitotic division of polyploid cells into normal cells with seven bivalents each. Most interesting is the observation that when cells receive more than the haploid number, the extra bivalents are eliminated and a normal cell is organised. Whether these polyploid cells actually lead to the formation of unreduced gametes has yet to be investigated. Such polyploid cells have also been recorded in *C. capsularis*. In case unreduced gametes do function, a population of triploids must be expected.

C. siliquosus is a natural polyploid with fourteen bivalents at first metaphase. Multivalents are not frequent and their number is not high. Bivalent pairing is the rule which indicates that the species is a polyploid of age. Fertility is high.

In *C. olitorius* pollen mother cells with 6 bivalents and 2 univalents due to lack of pairing have been observed. Laggards have been observed at first metaphase and all do not reach the poles.

In *C. trilocularis* seven bivalents are the rule but in several pollen mother cells, 6 bivalents and 2 univalents or 5 bivalents and four univalents have been noted due to lack of pairing.

Induction of mutations by the use of irradiated pollen.— Irradiation as a means of inducing mutations is a well known practice. Generally the practice is to irradiate seeds and raise an X_1 generation from which selections are made from the large number of morphological and physiological variants. But a more potent method is to irradiate the pollen grains which are expected to induce alterations in the karyotype.

Fresh pollen grains of *C. capsularis* and *C. olitorius* were exposed to X-radiation from the millionvolt tube of the Chittaranjan Cancer Hospital. The intensities employed were

60 r units, 80 r units and 120 r units. The irradiated pollen was used both for self- and cross-pollinations. The pollen had to be collected in the Chinsurah farm, rushed to Calcutta and back to Chinsurah after irradiation. This meant considerable delays. One serious disadvantage was that flowers of *C. olitorius* open very early and their period of receptivity is short lived. The whole project was carried out under difficult experimental conditions. Self- and cross-pollinations with *C. olitorius* were far from successful. Pods were formed in a few and the seeds are being sown this season.

Study of colchicine induced polyploids in C. olitorius.— Colchicine polyploids of *C. olitorius* now in the C_2 generation were studied to see if they were cytologically stable. Although multivalents were formed, the fertility is high and advantage was taken of this fact to make crosses between the tetraploids and the diploids. The object is first to induce genetic diversity among the tetraploids and the second is to raise a triploid line. The crosses were successful and the seeds are being sown this season.

IV. PHYSIOLOGICAL INVESTIGATIONS

1. Investigations on the Physiology of Jute Seeds

The investigations on the physiology of jute seeds started in 1950-51, were continued in greater detail in 1951-52 with the following varieties—Fanduk(early), D154(late) for *capsularis* jute, and C. G. and R26 for *olitorius* jute. Studies were based on three random plants from each of the 4 replicated plots, *i.e.*, 12 plants per variety. Studies were made from the following aspects :—

(*i*) Rate of flower opening and the nature of flowering period, (*ii*) Number of seeds formed in capsules developed at different times of the flowering period and (*iii*) the viability efficiency of the seeds formed in capsules developed at different times of the flowering period.

(*i*) *Rate of flower opening and the nature of flowering period.*—The results indicated the range of flowering period from the initiation of first flower opening in the different

varieties. The data on the average rate of flowering per week has been presented in Table V. The initiation of first flower opening differs in different varieties of *capsularis*—78th day from the date of sowing in Fanduk (early type) and 104th day in D154 (late type) while in *olitorius* both C.G. and R26 flowering started from 78th day. The duration of flowering period in D154 was of a comparatively shorter period beginning from 104 days of growth to 132 days, *i.e.*, about 4 weeks, the maximum flush being obtained in 2nd week, while in Fanduk flowering continued for a period of 6 weeks, the maximum being reached on the 3rd and 4th week. In *olitorius* both in C.G. and R26 the flowering period was more prolonged (10 weeks), but the average number of flowers opened per week was found to be less than that in *capsularis* and the maximum flush attained more than once. The nature of the flowering period and its range, therefore, varied in *olitorius* and *capsularis* species. In *capsularis* the sequence of flush of flowering was more rapid within a shorter range, while in *olitorius* the sequence of flowering was more prolonged over a wider range distributed in periodic flushes.

(*ii*) *Number of seeds formed in capsules developed at different times of flowering period.*—The capsules developed from flowers opened at different times of the flowering period were recorded and labelled on the plants. After they have fully matured they were collected and grouped under different dates. The seeds including the undeveloped ones were collected and tested for germination. The average percentage germination in different weeks has beeen presented in Table V.

The results showed that the average number of seeds formed in each capsule varied in accordance to the time of flower opening and consequent fruit setting. Larger number of seeds were formed in the capsules developing at earlier weeks of the flowering period and definitely decreased in the later period of flowering range. The sequence of fruit formation as expected corresponded with the optimum period of flowering. The above behaviour was found true in both *capsularis* and *olitorius* with the difference that in *olitorius*, capsules with higher number of seeds were formed on a wider

TABLE V

Showing average rate of flower opening, number of seeds formed per capsule & their germination capacity.

Capsularis & Olitorius

Sowing date—27-5-1951.

		Days of flower opening from sowing date ...	1st week 104-111 days	2nd week 112-118 days	3rd week 119-125 days	4th week 126-132 days	5th week	6th week	7th week	8th week	9th week	10th week
Capsularis	D154	Average number of flowers	3·2	7·0	4·5	1·5	...	...	...	...	...	...
		Average No. of seeds per pod ...	36·1	36·1	34·7	30·6	...	...	...	...	...	...
		Average % of germination	97·3	94·7	94·4	69·3	...	...	...	...	...	...
	Fanduk	Days of flower opening ...	78-84 days	85-91 days	92-98 days	99-105 days	106-112 days	113-119 days	...	...	...	...
		Average number of flowers	3·4	3·8	5·8	5·5	2·3	1·9	...	...	...	...
		Average No. of seeds per pod	35·9	33·6	38·1	37·1	32·4	...	...	...	...	...
		Average % of germination	92·7	96·1	96·4	96·2	83·4	...	...	...	...	...
Olitorius	C.G.	Days of flower opening ...	82-88 days	89-95 days	96-102 days	103-109 days	110-116 days	117-123 days	124-130 days	131-137 days	138-144 days	145-151 days
		Average number of flowers	1·3	1·8	2·5	3·2	2·0	3·8	2·6	2·1	2·2	3·0
		Average No. of seeds per pod	152·4	142·1	142·3	167·0	146·3	125·4	123·1	...	...	...
		Average % of germination	46·4	79·8	75·8	83·6	87·1	86·0	84·3	...	...	...
	R26	Days of flower opening ...	82-88 days	89-95 days	96-102 days	103-109 days	110-116 days	117-123 days	124-130 days	131-137 days	138-144 days	145-151 days
		Average number of flowers	1·3	2·0	4·1	3·0	2·3	4·0	3·5	2·4	2·6	3·0
		Average No. of seeds per pod	158·4	155·0	144·3	194·6	197·0	146·4	112·0	...	...	...
		Average % of germination	89·5	83·1	99·2	81·8	85·7	67·3	64·1	...	...	...

range of flowering period. In D154 the number of seeds varied from 30.6 to 36.1 and in Fanduk from 32.4 to 38.1 the maximum number being attained in 2nd and 3rd week. In C.G. the number of seeds varied from 123 to 167 and in R26 from 112 to 197, the maximum number being attained in 4th and 5th week of flowering, and minimum being found in the later periods of flowering range.

(*iii*) *Viability efficiency of seeds formed in capsules developed at different times of the flowering period.*—The average percentage germination of seeds in capsules collected at different weeks of flowering period also varied according to the rate of flower opening and the time of capsule development. Higher percentage of germination was noted in the seeds collected from capsules developed in the earlier weeks of flowering period, which decreased in the later weeks in D154 and Fanduk. In C.G. and R26, the higher percentage of germination was noted in the middle weeks which gradually decreased in the later weeks of flowering period. The results have been shown in Table V.

(*iv*) *Effect of pre-sowing cold treatment* (*Vernalization*).—Soaked seeds of D154 and C.G. were treated at 10°C for a period of 26 days in a refrigerator. They were sown in earthen pots against untreated seeds as control. Preliminary results showed that the leaves of the treated seedlings had darker green colour than those in the control and the rate of growth of the stem was more vigorous in the early stages of the vernalized seedlings. But no effect was noticed on the initiation of reproductive stage as a result of presowing cold treatment.

2. Salt Resistance Experiments with Jute Seedlings

Preliminary experiments were planned with D154 and C.G. seedlings to find out their resistance to different salt-concentrations. The salt (NaCl) content was made upto 1.5% of the soil and maintained at that concentration as far as possible. The growth rate and time of flowering and pod formation were recorded. It was found that due to excessive salt in the soil the plants were stunted in growth and the leaves were pale-yellow in colour, showing less of chlorophyll development as compared

to the control. Very few flowers and pods were formed. No definite result was obtained as to specific difference of *olitorius*. and *capsularis*.

3. Root System in Jute Species

Root-study was continued in C. G., D154, *Hibiscus cannabinus* and *H. Sabdariffa* var. *altissima* at different stages of growth. Root-washings were done in situ in the clay soil of Chinsurah farm after one month of growth and then at the time of bud initiaton. The differences in the root habits noted last year were furrher elaborated. Growth and distribution of roots at various stages was further continued. The length of tap root in one month old D154 plants was 2.5-4.0″ with small secondary roots, while in C.G. it was 4.0 to 6.5″. At the bud stage the tap root elongated to 10.0″ to 12.4″ in D154 and 19.4″ to 20.6″ in C.G. in many of the washings the tap root was found to be bifurcated and of short length. As noted previously secondary roots in *capsularis* were more numerous, superficial and bushy in nature, while in *olitorius* they were well developed and more deeply penetrative.

4. Physiology of Growth in Different Species and Varieties of Jute with Reference to Moisture Content, Bark and Fibre Growth and Wood Formation During the Life-Cycle of the Plant

Preliminary results on D154 (*capsularis*) and C.G. (*olitorius*) sown in Chinsurah farm on 20-5-50 have been reported in the annual report of 1950-51. Remaining materials in case of other varieties have been worked out during 1951 and the results on the following *capsularis* and *olitorius* varieties are now reported.

Capsularis		*Olitorius*	
(*a*)	Fanduk	(*a*)	R26
(*b*)	C-41-13	(*d*)	O40-753
(*c*)	C39-212	(*c*)	O39-620
(*d*)	C42-Kj-320	(*b*)	O40-632

Ten plants were selected at random in each replicated plot and marked for periodical growth rate in height, basal diameter, leaf output, date of bud formation and flowering,

and pod formation. In addition to the above, actual growth rate in the stem was recorded in terms of dry weight formed.

Three random plants from each plot or 12 plants per variety were cut at the ground level. They were brought immediately to the laboratory and after removing the leaves each stem was divided into small segments of 6″ each beginning from the base to the apex. The samplings were made at intervals of 7 days. After taking the green weights dry weights were taken by drying the samples in an electric oven at 60° to 80°C. Results obtained on the comparative equal heights of the stem upto 78″ in different varieties of *capsularis* and *olitorius* at four important phases of growth have been reported under the following headings :—

(*a*) Dry weight of different regions of the stem at different stages of growth as shown by the dry weight of bark and wood.

(*b*) Moisture content in the different regions of the growing stem at different stages of growth of plant.

(*c*) Individual variations in the dry weight of the wood and bark and the ratio of their formation at different regions and at different stages of growth.

From the above category of results, informations on the following aspects were obtained. (*i*) The rate of total growth in terms of dry matter, (*ii*) the relation of moisture content per unit of dry matter produced, (*iii*) the comparative rate of formation of wood in relation to the growth of the bark, (*iv*) the ratio of growth of bark to that of wood at different periods of growth and at different lengths of the stem, and (*v*) the comparative rate of pure fibre production in relation to crude bark formation.

(*i*) *Variation in dry-weight.*—The variations in dry weight at different levels of the stem and at different stages of plant growth have been tabulated in Table VI for *capsularies* varieties and in Table VII for *olitorius* varieties.

The results indicated similar trends of dry material formed as reported in the last annual report (1950-51) in the case of D154 and C.G. The maximum dry matter was found

always in the basal regions which is correlated with the advance in age of the plants. The apical portions of the stem showed lesser amount of dry material. This was true in all the varieties, but with specific and varietal differences in the rate of formation of dry matter in the different varieties of *capsularis* and *olitorius*. It has been seen that more dry matter was formed in the basal region of the *capsularis* stem than in the *olitorius* but in *olitorius* the dry matter was more evenly distributed along the whole length of the stem, resulting in the formation of more dry matter in the *olitorius* varieties than in *capsularis* varieties for the same length of stem which has been calculated in these studies upto 78″. It has been seen that formation of total dry matter increased with the progress of vegetative stage towards reproductive stage. The sequence of changes in growth in terms of dry matter formation taken either along the stem from the basal to apical regions or from one phase of growth to the other during the life history of the plant was same in all the varieties of both the species. Some marked varietal differences in the growth of dry matter were noticed in the varieties of *olitorius* species. In all the three varieties R26, O40-632 and O40-753 the formation of dry matter took place with a higher initial value than O39-620. But in later stages of growth O39-620 showed the maximum formation of dry matter than all other varieties. This throws light on the genetic nature of growth in O39-620 which was further supplemented by the fact that values obtained for quality ratio was found higher in O39-620 than in other varieties.

(*ii*) *Variations in moisture content.*—The moisture content in the stem at different heights varied from apical regions to basal regions. The calculated percentage of moisture variations on dry matter formed showed a gradual increase from base towards the apical regions as has been reported previously in case of D154 and C.G. The maximum moisture content was no doubt obtained in the apical regions which was associated with the vegetative growth of young cells. Further, the maximum demand for moisture was found to be in the vegetative stage and in the transition stage from vegetative to reproductive stage. The moisture content in the pod stage has been found to be much less and this decrease was due

to the formation of woody matter and gradual slowing down of the metabolic processes of growth. The total variation in the whole length of stem was found to be of the same order in both the species during the progress of the season.

(*iii*) *Variations in the formation of bark and wood at different stages of growth.*—The results obtained confirmed the variations and the sequence of changes in the bark formation as shown previously in the case of D154 and C.G. The amount of bark formed in the basal regions 0-6″; 6-12″ and 12-18″ was found to be always more than that in subsequent upper regions of the same stem. The same relation was maintained in all the stages, showing basal regions to be the seat of maximum bark formation, which gradually decreased towards the apical regions. This tendency was maintained throughout the growing season in all the varieties of *capsularis* or *olitorius* jute, with specific differences. The quantity of bark formed as shown by the dry weight at different heights of the stem varied from vegetative to bud stage and then to pod stage.

The rate of bark formation was different in different species. The total bark formed in *capsularis* as compared to that formed in *olitorius* for the same length of stem was found to be more in *olitorius* than in *capsularis*. The above holds good in all the varieties of *olitorius* and when compared with other varieties of *capsularis*, which have been worked upon in the present studies. In Table VIII the values of total bark for equal lengths of stem at different stages have been compared.

The values of total bark formed indicated that more bark was formed for the same length of stem in *olitorius* than in *capsularis*. But in early vegetative stage the difference was not so well marked as in later stages. Amongst the varietal differences in *olitorius* it was found that in O39-620 the initial value of bark was much less than other varieties but the rate of increase was more rapid which ended in the maximum production of bark in the last stage. This corresponded with the changes of dry matter as pointed out before. In *capsularis* varieties C41-13 showed a minimum initial value of bark formation than other varieties but in the later period showed maximum bark formation. These changes showed the nature of growth amongst the different varieties of the same species, which would be extended for further studies in the evolution of desired types.

TABLE VI

Showing variations in dry matter in different varieties of Corchorus capsularis

Sowing date 20-5-50

Dry weight in gms.

Height of the stem	C41-13				C39-212				C42-Kj-320			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
0 - 6" ...	·748	1·375	2·229	4·019	·816	1·213	2·005	3·408	1·057	1·446	2·207	3·745
6"- 12" ...	·481	·974	1·688	2·949	·498	1·005	1·550	2·783	·719	1·014	1·621	2·927
12"-18" ...	·364	·806	1·477	2·726	·380	·838	1 321	2·524	·631	·832	1·397	2·611
18"-24" ...	·263	·686	1·338	2·580	·368	·706	1·209	2·317	·526	·679	1·248	2·396
24"-30" ...	·216	·551	1·187	2·337	·271	·586	1·099	2·123	·375	·585	1·110	2·241
30"-36" ...		·458	1·040	2·187		·486	·905	1·991		·501	1·002	2·066
36"-42" ...		·373	·927	1·994		·379	·834	1·810		·415	·766	1·940
42"-48" ...		·250	·783	1·838		·288	·706	1·653		·331	·782	1·754
48"-54" ...		·182	·668	1·693			·614	1·482		·243	·653	1·570
54"-60" ...			·527	1·526			·485	1·297			·508	1·420
60"-66" ...			·397	1·321			·375	1·101			·442	1·240
66"-72" ...			·282	1·110				·931			·322	1·019
*72"-78" ...				·985				·762				·893
Total dry weight ...	2·072	5·649	12·543	27·265	2·333	5·510	11·103	24·185	3·308	6·046	12·058	25·822

I ... 51 days from sowing corresponded to vegetative stage
II ... 72 ,, ,, ,, ,, ,, Bud ,,
III ... 93 ,, ,, ,, ,, ,, Flowering ,,
IV ... 121 ,, ,, ,, ,, ,, Pod ,,

*In these experiments upto 78" of the height of the stem was taken for comparison of equal heights in different varietes of *capsularis* and *olitorius* though the ultimate height was much more.

TABLE VII

Showing variations in dry matter in different varieties of Corchorus olitorius

Sowing date 20-5-50

Dry weight in gms.

Height of the stem	R-26				O40-632				O40-753				O39-620			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
0-6" ...	·914	1·994	2·083	3·998	·830	1·699	2·453	4·413	1·031	1·653	2·300	3·305	·635	1·881	2·349	4·299
6"-12" ...	·709	1·547	1·616	3·203	·623	1·313	1·977	3·705	·748	1·292	1·846	2·826	·430	1·423	1·805	3·542
12"-18" ...	·539	1·298	1·419	2·879	·464	1·118	1·761	3·460	·539	1·116	1·647	2·618	·333	1·182	1·617	3·245
18"-24" ...	·421	1·097	1·243	2·644	·360	·959	1·577	3·279	·459	·970	1·468	2·488	·289	·946	1·420	2·985
24"-30" ...	·359	·901	1·087	2·533	·406	·819	1·431	3·062	·331	·852	1·350	2·330	·242	·887	1·302	2·803
30"-36" ...		·783	·953	2·301		·701	1·292	2·914		·748	1·213	2·208		·762	1·094	2·645
36"-42" ...		·614	·819	2·114		·577	1·151	2·739		·592	1·089	2·093		·624	·936	2·466
42"-48" ...		·505	·677	2·001		·504	1·022	2·618		·495	·940	2·006		·499	·811	2·362
48"-54" ...		·424	·563	1·874		·330	·884	2·450		·373	·810	1·943		·299	·679	2·174
54"-60" ...			·451	1·766		·254	·723	2·292		·295	·670	1·721			·589	2·137
60"-66" ...			·348	1·608			·600	2·127		·181	·546	1·566			·472	1 931
66"-72" ...				1·416			·492	1·962			·435	1·415			·418	1·757
72"-78" ...				1·315			·406	1·839			·320	1·249				1·608
Total dry wt.	2·942	9·163	11·259	29·656	2·683	8·274	15·769	36·860	2·938	8·567	14·634	27·768	1·929	8·503	13·492	33·964

I—51 days from sowing corresponded to vegetative stage

II—72 ,, ,, ,, ,, ,, bud ,,

III—93 ,, ,, ,, ,, ,, flowering ,,

IV—121 ,, ,, ,, ,, ,, pod ,,

(iii) *Percentage formation and distribution of bark in the stem.*—The contribution of bark weight to the weight of total dry material formed at different stages when calculated, showed interesting results. The percentage of bark in terms of dry weight showed that it formed more or less half of the total dry material, the value of which varied in different stages. The percentage of bark was always more in early stages of vegetative to flowering stages than in the later pod or post-pod stages in both *olitorius* and *capsularis* varieties. This was further confirmed by the study of the dry weights of wood formed at different stages, and the comparative ratio of the formation of these two elements. The percentage of bark in terms of dry weights at different stages for equal length of stems has been represented in Table IX.

TABLE VIII

Total bark formed for equal lengths of stem at different stages.

(Dry weight of bark in gms.)

Different stages	51 days Vegetative stage.	72 days. Bud stage	93 days. Flowering stage	121 days. Pod stage
Length of stem	0-30″	0-48″	0-72″	0 78″
Capsularis				
1. D154 ...	1·274	2·623	5·981	10·900
2. C39-212 ...	1·215	2·704	5·742	11·195
3. C41-13 ...	0·948	2·776	6·075	12·290
4. C42-Kj-320 ...	1·723	2·964	5·737	11·254
Olitorius				
1. C. G. ...	1·023	3·652	6·523	13·377
2. R26 ...	1·620	4·636	5·317	11·992
3. O40-632 ...	1·507	4·220	8·035	16·903
4. O39-620 ...	0·954	4·222	7· 00	15·418
5. O40-753 ...	1·828	4·209	7·981	13·328

TABLE IX

Total Dry weight, Total bark weight and percentage of bark weight in terms of dry weight.

C. capsularis.

Varieties	C41-13				C39-212				C42-Kj-320			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Total length of the stem ...	30″	54″	72″	78″	30″	48″	66″	78″	30″	54″	72″	78″
Total dry wt. ...	2·072	5·649	12·543	27·265	2·333	5·510	11·103	24·185	3·308	6·046	12·058	25·822
Total bark wt. ...	·948	2·776	6·075	12·290	1·215	2·704	5·742	11·195	1·723	2·964	5·737	11·257
% of bark in terms of dry wt. ...	45·74	49·14	48·43	45·08	52·08	49·07	51·72	46·29	52·09	49·02	47·58	43·78

C. olitorius.

Varieties	R26				O40-632				O40-753				O39-620			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Total length of the stem ...	30′	54″	66″	78′	30″	60″	78″	78″	30″	66″	78″	78″	30″	54″	72″	78″
Total dry wt. ...	2·942	9·163	11·259	29·656	2·683	8·274	15·769	36·860	2·938	8·567	14·634	27·768	1·929	8·503	13·492	33·964
Total bark wt. ...	1·620	46·36	5·317	11·992	1·507	4·220	8·035	16·903	1·828	4·209	7·981	13·328	·954	4·222	7·200	15·418
% of bark in terms of dry weight ...	55·06	50·59	47·22	40·44	56·17	51·00	50·95	45·86	62·22	49·13	54·54	48·00	49·46	49·65	53·36	45·40

I ... 51 days from sowing corresponded to vegetative stage.
II ... 72 ,, ,, ,, ,, ,, bud ,,
III ... 93 ,, ,, ,, ,, ,, flowering ,,
IV ... 121 ,, ,, ,, ,, ,, pod ,,

TABLE X

Percentage distribution of bark calculated on total dry weight of bark of the stem.

C. capsularis

Varieties	C41-13				C39-212				C42-Kj-320			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Bottom	60·86	57·64	49·37	50·17	57·20	52 85	52·09	49·76	51·01	53·54	46·38	50·62
Middle	29·32	29·47	33·48	32·64	31·44	34·32	33·32	33·37	38·19	29·56	34·76	33·36
Top	9·81	12·90	17·15	17·19	11·36	12·83	14·59	16·87	10·80	16·90	18·86	16·02

C. olitorius

Varieties	R 26				O40-632				O39-620				O40-753			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Bottom ...	56·42	52·22	52·06	49·36	53·35	60·59	51·68	51 89	56·08	51·75	48·26	47·41	55·58	57·07	54·98	48·26
Middle ...	30·93	29·81	33·87	33·81	31·32	25·81	34·48	31·29	30·92	31·24	33 49	33·73	34·35	32·79	32·64	35·28
Top ...	12·65	17·97	14·07	16·83	15·33	13·60	13·84	16·82	13·00	17·01	18·25	18·86	10 07	10·14	12-38	16·45

I—51 days from sowing corresponded to vegetative stage
II—72 ,, ,, ,, ,, ,, bud ,,
III—93 ,, ,, ,, ,, ,, flowering ,,
IV—121 ,, ,, ,, ,, ,, pod ,,

(*v*) *Percentage distribution of bark.*—The experimental 6″ regions have been further grouped in order to find out the distribution of bark in three broad regions of main stem *viz.*, bottom, middle and top. Though the length of the individual regions varied from stage to stage according to the linear growth of the stem, yet the values of each stage are comparable to the corresponding stage of different species and varieties and also gave a clear comparable idea of distribution of bark with the progressive growth of the stem as represented in the Table X.

The above results showed as indicated previously that the maximum percentage of distribution of fibre was found to be in the bottom regions. The varietal differences are noted but considering the two species it may be mentioned that in *capsularis* varieties a higher percentage of bark distribution was found in the bottom regions in the early vegetative stage than in *olitorius* varieties. But the middle and top regions of *olitorius* varieties recorded more bark percentage than in *capsularis* varieties.

(*vi*) *Variation in the wood formation.*—Together with the study of variations of bark formation, corresponding variations in the wood formation were also determined. The results obtained were similar to those of bark formation and the variation were of the same type, showing similar growth and development in the two main components forming the total dry matter of the stem.

The results indicated the similar sequence of changes in both *capsularis* and *olitorius* varieties, showing that both bark and wood were formed in definite proportions. The ratio of wood growth was slower in the early stages than in the later stages, while the maximum amount was found in the bottom regions than in the apical ones. The wood continued to grow and develop with the minimum value in the vegetative stage to the maximum value in the pod stage. With the transition from vegetative to the reproduction phase, the variations in wood formation became more marked. Like bark growth, wood growth was also found to be more in the varieties of *olitorius*

than in the varieties of *capsularis*. The total wood content in the different stages in different varieties have been represented in Table XI.

TABLE XI

Total wood formed for equal lengths of stem at different stages.

(Dry wt. of wood in gms)

Different stages	51 days. Vegetative stage	72 days. Bud stage	93 days. Flowering stage	121 days pod stage
Length of stem	0 - 30″	0 - 48″	0 - 72″	0 - 78″
Varieties				
(*Capsularis*)				
1. D154 ...	1·162	2·391	5·943	13·209
2. C39-212 ...	1·118	2·797	5·361	12·987
3. C41-13 ...	1·124	2·873	6·468	15·011
4. C42-Kj-320 ...	1·585	3·082	6·321	14·565
(*Olitorius*)				
1. C. G. ...	1·017	3·655	6·820	16·083
2. R26 ...	1·322	4·554	5·942	17·660
3. O40-632 ...	1·176	4·054	7·734	19·957
4. O39-620 ...	0·975	4·281	6 292	19·532
5. O40-753 ...	1·310	4·358	6·653	14·436

The values of total wood content showed that for the same length of stem more wood was formed in the later stages in *olitorius* than in *capsularis* varieties. In the early vegetative stage no such marked difference was noticed but the rate of early formation of wood in *olitorius* was recorded. Individual

varietal differences and the rate of wood formation were clearly brought out. The comparison of total bark weight and total wood weight showed that both the components varied in definite proportions and the growth of one was closely related with the growth of the other.

(*vii*) *Ratio of bark formation to that of wood formation.*— The above inter-relationship has been clearly brought forward by the result calculated as the ratio of bark formation to that of wood formation where the mean values of bark weights have been represented as ratio of unit value of wood formation. The results have been tabulated in Tables XII and XIII in different varieties of *capsularis* and *olitorius*.

The values tabulated above showed the sequence of changes in bark formation in relation to the formation of wood during the season and also at different heights of main stem. The important results as reported last year in case of D154 and C.G. have been confirmed in other varieties also. They may briefly be summarised as :—

(1) The growth of bark (represented by the dry weight) exceeded that of wood in the vegetative to flowering stage because the ratio varied more than unity, (2) in pod stage the weight of wood exceeded that of bark because the ratio varied less than unity, (3) the ratio was differently maintained on the stem according to the stage and height of the plant, *i.e.*, secondary wood formation took place from the bottom and advanced up to the stem, thus shifting the fibre ratio towards the apex maintaining varietal differences, (4) the fibre formation was shifted and maintained in the upper region of the stem as the plant entered the flowering stage, (5) the fibre ratio was maintained higher in a larger number of zones worked out in these studies in the flowering to pod-stage than in any other

TABLE XII

Ratio of bark formation to that of wood formation in different varieties of Capsularis

Varieties	C39-212				C41-13				C42-Kj-320			
Height of the stem	I	II	III	IV	I	II	III	IV	I	II	III	IV
0-6" ...	1·159	0·708	0·874	·712	·928	1·096	·685	·815	·972	·913	·576	·673
6"-12" ...	1·066	0·955	0·877	·708	·822	1·051	·671	·721	·992	·943	·586	·685
12"-18" ...	1·054	1·079	1·090	·888	·876	·901	·999	·798	1·346	·948	·916	·792
18"-24" ...	1·033	1 046	1·136	·901	·697	·938	1·024	·843	1·287	·891	·888	·772
24"-30" ...	1·038	1·108	1·176	·887	·756	·907	1·019	·788	·984	·990	·972	·804
30"-36" ...		1·141	1·034	·896		·957	1·068	·818		1·123	1·070	·780
36"-42" ...		1·722	1·242	·901		·952	1·116	·806		1·161	1·632	·800
42"-48" ...		1·000	1·285	·918		·773	1·094	·822		1·018	1·384	·777
48"-54" ...			1·266	·912		·625	1·190	·877		·841	1·267	·780
54"-60" ...			1·343	·942			1·322	·893			1·190	·873
60"-66" ...			1·373	1.035			1·218	·830			1·376	·854
66"-72" ...				1·006			1·351	·850			1·350	·887
72"-78" ...				1·037				·994				·929

I—51 days from sowing corresponded to vegetative stage
II—72 ,, ,, ,, ,, ,, bud ,,
III—93 ,, ,, ,, ,, ,, flowering ,,
IV—121 ,, ,, ,, ,, ,, pod ,,

TABLE XIII

Ratio of bark formation to that of wood formation in different varieties of Olitorius

Variety	R 26				O40-632				O40-753				O39-620			
Height of stem	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
0—6″	1·146	1·016	0·647	·504	1·202	0·976	0·626	0·679	1·327	0·837	0·969	0·765	1·042	0·877	0·723	0·666
6″—12″	1·505	1·105	0·708	0·534	1·290	1·091	0·701	0·725	1·338	0·952	1·056	0·834	0·963	0·999	0·831	0·744
12″—18″	1·097	0·870	0·910	0·661	1·263	0·979	1·094	0·858	1·671	0·941	1·139	0·863	0·800	1·014	1·224	0·806
18″—24″	1·084	0·931	0·945	0·681	1·449	1·002	1·061	0·863	1·455	0·972	1·146	0·915	1·035	0·915	1·212	0·813
24″—30″	1·331	0·959	0·998	0·776	1·320	1·037	1·098	0·859	1·252	1·058	1·224	0·942	1·051	1·097	1·471	0·848
30″—36″		1·111	1·023	0·746		1·111	1·212	0·880		1·095	1·242	0.959		1·123	1·333	0·889
36″—42″		1·081	1·084	0·708		1·106	1·205	0·913		1·041	1·283	0·958		1·189	1·340	0·872
42″—48″		1·158	1·070	0·725		1·100	1·388	0·904		1·012	1·287	1·020		1·170	1·414	0·903
48″—54″		1·279	1·157	0·753		1·050	1·188	0·888		1·144	1·282	0·979		0·582	1·399	0·858
54″—60″			1·289	0·802		1·248	1·426	0·904		0·980	1·428	0·976			1·765	0·934
60″—66″			1·231	0·753			1·679	0·930		0·828	1·551	0·987			1·579	0·912
66″—72″				0·799			1·733	0·939			2·246	1·059			1·533	0·944
72″—78″				0·860			1·800	0·961			1·712	1·048				0·963

I—51 days from sowing corresponded to vegetative stage
II—72 ,, ,, ,, ,, ,, bud ,,
III—93 ,, ,, ,, ,, ,, flowering ,,
IV—121 ,, ,, ,, ,, ,, pod ,,

stage, (6) the ratio was always maintained within a very limited range showing the close co-ordinative growth between these two components.

(viii) Variations of pure fibre content at different stages of growth in jute by chemical determination.—The above work was done in plants sown on 27.5.51 at Chinsurah farm. Variation in the growth of crude bark and wood have been reported before. In order to find out the formation of pure fibre in relation (*a*) to the crude bark formed, (*b*) to the dry matter (bark & wood), (*c*) to the growth of fibre at different stages. Analysis of different samples were made after separating the pure fibre through chemical retting process. The dried crude bark estimated before were soaked over-night in tap water as pre-softening treatment. Excess of water was removed by draining for a few minutes and then placed in a beaker containing 4% NaOH sol. in the ratio of 40 parts by volume of the solution to 1 part by weight of dried crude bark. The beaker was covered with a watch glass and the solution was gently boiled for 30-40 minutes with frequent stirring. The contents of the beaker was then washed in running tap water to remove the alkali, other portions of the bark and the soluble constituents from the fibre. Further purification in the fibre was made by partial bleaching treatment which was done by agitating the washed fibre for 1 minute at room temperature in 1000 c.c. of water containing 0.5 parts of chlorine—as sodium hypochlorite. The solution was made slightly acidic with 5% acetic acid solution, stirred and the fibre immediately removed and washed. The washed fibre was next agitated in 1000 c.c. of water containing a few crystals of dissolved sodium thiosulphate as an antichlor, then thoroughly washed, squeezed with hand and dried in a constant temperature oven. The dried weight of the fibre was taken.

TABLE XIV

Showing distribution of pure fibre in relation to (a) total dry matter and (b) bark at different stages of growth

Dry weight in gms. Sowing date 27-5-51

D154 (*capsularis*)

Date from sowing date	43 days	57 days	71 days	85 days	99 days	113 days	127 days
Total length of the stem ...	30″	42″	42″	72″	72″	72″	72″
Total wood weight ...	1·58	4·95	7·95	12·56	15·70	23·32	19·87
Total bark weight ...	1·52	4·40	6·77	10·52	12·49	15·66	13·30
Total dry weight (bark and wood)	3·10	9·35	14·72	23·08	28·19	38·98	33·17
Total pure fibre weight ...	0·66	2·48	3·61	6·03	6·88	9·72	7·59
% of pure fibre in terms of total dry weight ...	21·35	26·55	24·52	26·13	24·41	24·94	22·88
% of pure fibre in terms of bark weight ...	43·61	56·43	53·32	57·32	52·48	58·55	53·68

C. G. (*olitorius*)

Total length of the stem ...	30″	54″	72″	72″	72″	72″	72″
Total wood weight ...	2·17	8·72	19·94	28·09	31·93	37·01	45·10
Total bark weight ...	2·06	6·40	12·09	16·58	17·29	17·56	21·80
Total dry weight (bark and wood)	4·23	15·12	32·03	44·67	49·22	54·57	66·90
Total pure fibre weight ...	0·98	3·33	6·76	10·16	10·45	11·37	13·51
% of pure fibre in terms of total dry weight ...	23·05	22·02	21·11	22·74	21·23	20·83	20·19
% of pure fibre in terms of bark weight ...	47·45	52·05	55·91	61·28	60·44	64·75	61·97

The following results were obtained : (1) Variations in formation of pure fibre at different stages of growth and at different heights of the main stem. (2) Percentage of pure fibre on total dry material produced at each stage of growth. (3) Percentage of pure fibre on total dry crude bark produced at each stage of growth. (4) Percentage distribution of pure fibre on total dry material (bark and wood). The results showing the distribution of pure fibre in terms of dry matter (dried stalk) bark and wood at different stages of growth in D154 (*capsularis*) and C.G. (*olitorius*) are represented in Table XIV.

Considering the percentage variation of pure fibre production in terms of crude bark it was found that in D154 in early stages of vegetative growth about 44% of fibre was formed which later increased in the flowering stage to 53 to 59% of crude bark and again at pod stage the percentage decreased. Similarly the percentage of pure fibre calculated on total dry material remained low in the vegetative stage and increased in the flowering stage. The optimum fibre percentage was found to vary from 24% to 26% in the flowering stage calculated on total dry material which can also be taken as dried jute stalk. In C.G. the percentage variation of pure fibre production showed the same sequence of changes but the percentage fibre on crude bark weight for each stage was found to be more than in D154. In early vegetative stage 48% of fibre was recorded in C.G. and during the flowering period the optimum percentage varied from 55% to 65%. When the production of fibre was calculated on the total dry matter of each stage it was found that excepting in the early vegetative stage C.G. showed a lower percentage (21% to 23%) in each stage of equal length of stem than those of corresponding stages of D154. This was found to be interesting on the fact that C.G. showed higher percentage of fibre on crude bark than D154, but when total dry matter (which included the weight of wood) was considered the percentage of fibre decreased from that of D154 indicating more wood formation in C.G. than D154. In general it was found that more or less a quarter part of the total dry matter (wood and bark) formed, consisted of fibre elements.

V. JUTE AGRONOMY

1. Line Sowing of Jute

(*i*) *Growing of jute as a row crop.*—To study the possibilities and economics of growing jute as a row crop as against the usual broadcast crop, two trials, one with *capsularis* and the other with *olitorius* jute, were carried out during the year under report at Chinsurah farm. The spacing treatments in both the trials were same as last year, namely, (*i*) Light thinning × 12 inches; (*ii*) 2 inches × 12 inches; (*iii*) 3 inches × 12 inches; (*iv*) 4 inches × 12 inches and (*v*) Broadcast as control. Line sowing, in the two trials, were done by hand-dibbling the seed in opened furrows and covered by planking.

The *capsularis* trial which was laid out in a midland suffered continually from water-logging due to seepage water from nearby irrigation channels and the growth of the crop suffered considerably. In the *olitorius* trial, germination was in more than 3 instalments mainly in the line plots, which were also somewhat gappy due to lack of uniform depth of sowing, covering and soil packing. The plants that germinated later remained stunted. All such plants could be removed in the gradual thinning operations given in the broadcast plots whereas in line plots, in order to keep to the requisite spacings within the lines in treatments this was not possible always and a large number of stunted plants had to be kept on. Consequently the yield in line plots was somewhat suppressed.

The data on yield, cost of production and profit values for each treatment in the two trials are presented in Table XV.

TABLE—XV.

Line Vs. Broadcast

C. capsularis (D154)

Layout—Replicated randomised layout in 4 replications

Effective plot size—0·0138 acre

Sown on 21·5·51 and harvested on 30·8·51.

Spacing treatments	Yield per acre (Maunds)	Percent yield on control	Cost of cultivation per acre (Rs.)	Percent cost on control	Profit per acre (fibre sold at Rs. 50/- per md. (Rs.)	Profit percent on control
A. Broadcast (control) ...	12·79	100·00	284·00	100·00	355·50	100·00
B. Light thinning ×12″	16·55	129·35	228·75	80·55	598·75	168·71
C. 2″×12″ ...	13·49	105·43	215·60	75·92	458·90	129·09
D. 3″×12″ ...	14·08	110·03	220·80	77·75	483·20	135·92
E. 4″×12″ ...	13·86	108·30	221·20	77·89	471·80	132·71
P ...	Large					
S. E.% ...	13·64					

C. olitorius (C. G.)

Layout—Replicated randomised layout in 4 replications.

Effective plot size—0·0124 acre.

Sown on 5·6·51 and harvested on 13·10·51.

Spacing treatments	Yield peracre (maunds)	Percent yield on control	Cost of cultivation per acre (Rs.)	Percent cost on control	Profit per acre (fibre sold at Rs. 50/- per md. (Rs.)	Profit percent on control
A. Broadcast (control) ...	18·93	100·00	323·7	100·00	622·80	100·00
B. Light thinning ×12″	19·34	101·75	261·9	80·91	705·10	113·22
C. 2″×12″ ...	18·61	97·91	253·7	78·38	676·30	108·59
D. 3″×12″ ...	18·06	95·00	246·9	76·27	656·10	105·35
E. 4″×12″ ...	18·83	97·09	252·4	77·97	689·10	110·65
P ...	Large					
S.E.% ...	1·8					

It will be noted from the table that no significant yield differences between the treatments were recorded though in *capsularis* trial, line plots gave higher yields than broadcast plots. In both the trials the cost of production in line plot was reduced by 20 to 25% than broadcast plots and the profit values in line plots were higher.

The results of line sowings are likely to improve considerably if suitable jute seed drills are used for sowing.

(ii) Line sowing in cultivators' plots.—Line sowings on a larger scale were done during 1951-52 season in some of the cultivators' plots adjacent to our farm. The increase in yields in line plots over the broadcast plots ranged from 13 to 23%. The cultivators who had initially hesitated much in allowing the trials to be conducted in their lands were satisfied and now realised the advantages of growing jute as a row crop.

2. Development of Jute Seed Drill

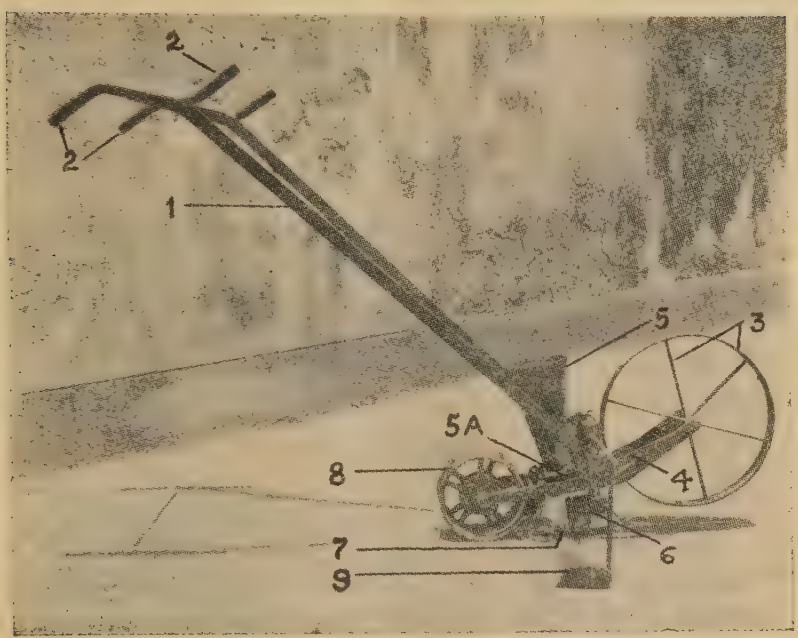
Last year it was reported that the hand-pushed seed drill developed by the Jute Agricultural Research Institute in collaboration with a local firm had shown some promise of success. This drill was tried in the farm of the J.A.R.I. and also in different States ; but many working defects were found. Further work was taken on hand in collaboration with the same firm and a fairly satisfactory drill has now been developed. Hundred pieces of this drill have been made for extensive field trials in the cultivators' plots in the various jute growing States of the Indian Union and distributed as follows :—

1.	Director of Agriculture, West Bengal ...	60
2.	Director of Agriculture, Bihar ...	8
3.	Director of Agriculture, Orissa ...	7
4.	Director of Agriculture, Assam ...	8
5.	Director of Agriculture, U.P. ...	7
6.	Director of Jute Agricultural Research Institute	5
7.	Director, Economic Research, I.C.J.C. ...	5
		100

Necessary training in the use of the drill was also given to the staff of the State Agricultural Departments concerned.

PLATE I

THE SEED DRILL IN SIDE VIEW



1—Handle ; 2—Grips ; 3—Wheel ; 4—Connecting member ; 5—Hopper ; 5A—Base plate ; 6—Furrower ; 7—Soil gatherer ; 8—Press wheel ; 9—Marker.

Description of the Hand Pushed Jute Seed Drill.—It is a single furrow hand pushed seed drill weighing about 34 lbs. The seed hopper (Pl-1-5) is fitted on a base plate (Pl-1-5A) mounted on the frame. The seed roller (Pl.II) is driven from the ground wheel (Pl-1-3), fitted in front, by a tandem connecting member (Pl-1-4). The shafts have connecting links actuating the connecting member. The roller rotates inside the hopper (Pl-1-5) carries the seed in holes on its circumference (Plate II) and drops them on the ground first behind the narrow furrow opener (Pl-1-6). Two soil gatherers (Pl.-1-7) behind the furrow opener cover the seed and a press-wheel (Pl-1-8) at the back packs the soil. Thus in one operation the furrow is opened, the seed dropped in the middle of the fur-

rows, covered with soil and packed with the press-wheel. A sliding marker (Pl-1-9) is also provided for marking the next line to be drilled. A long steel handle (Pl-1-1) is fitted to a plate on the frame which can be adjusted to the height of the operator of the drill. The handle has two sets of grips Pl-1-2) both in front and at the back to enable the operator to change position while working continuously.

Details of the construction are given below :—

(1) *Frame*—It mainly consists of two mild steel bars bent to connect the front wheel with the press wheel at the back. A bent mild steel rod 30″ long, acts as a marker (Pl-1-9) and it can be fitted at any desired position by a screw. The handle (Pl-1-1) is a long piece of mild steel bar bent and connected on both sides of plates welded to the main frame through semi-circular slots and it can be adjusted to the operator's height.

(2) *Front wheel (Pl-1-3)*—It is made of mild steel $1\frac{1}{2}''$ wide and 1/8″ thick. The diameter of the wheel is 14″. The wheel is fitted on an axle in between two main frame bars.

(3) *Seed Roller (Plate II)*—It is a disc of 2″ diameter and $\frac{1}{2}''$ thickness made of aluminium. The roller is fitted to the axle and kept in position by a brass holder. It rotates from the front wheel by a connecting link in clockwise direction within the hopper through a slit lined with a piece of felt. Seed holes are distributed evenly on the circumference of the roller. The number and size of the holes will depend on the type of seeds and rate of seeding. The roller is split into two halves so that rollers having different numbers and size of holes can be easily interchanged to enable sowing of different crop seeds.

(4) *Hopper (Pl-1-5)*—The hopper is conical shaped and made of sheet metal having a capacity of 2.5 lbs. of seed. It is fitted on a base plate on the frame and seed roller works inside it.

(5) *Furrower* (*Pl-1-6*)—This is made of cast iron and screwed to the front brace bar of the main frame through a slot. The depth of the furrow can be adjusted by moving the furrower up or down the slot. The bottom of the furrower is shaped with a tip at the front and wings carried well back. The seeds when dropped occupy just the middle of the narrow furrow and do not scatter.

(6) *Soil gather* (*Pl-1-7*)—Two adjustable soil gathers are provided behind the furrower to gather soil after seed has been dropped and cover it.

(7) *Press wheel* (*Pl-1-8*)—It is made of cast iron in two pieces and has a concave surface. It packs the soil all round leaving a tiny crack in the middle of the row just above the seed that helps emergence of the young germinating seedlings.

PLATE II

Interculture with wheel hoe in jute crop sown with hand-pushed jute seed drill.

The machine is well built and strong enough for its purpose. All the parts are made of iron and are durable except the felt, lining the roller, which is likely to wear off on use when fresh felt may be provided.

Dropping of seed is uniform and satisfactory without any damage to seed. The drill moves very easily and gives a satisfactory out-turn of work. A man working continuously for 5 to $5\frac{1}{2}$ hours can sow one acre of land with this drill. It, therefore, seems that it will not be difficult to command an area of about 15 to 20 acres with one drill. The machine should go a long way to popularise growing of jute in lines.

A photo of the drill and diagram showing the seed dropping mechanism are given in plates I and II.

A photo of wheel-hoe in 23 days old *olitorius* crop sown by the hand pushed drill is given in plate III.

It may, however, be noted that the drill requires further improvements to give more foolproof and satisfactory performance and sustained work in this connection has to be pursued. There is considerable room for improvement in the felting, soil gatherer, press-wheel, marker, depth and other adjustments and in the overall reduction of cost of the machine. It will be profitable to make the drill, if possible, a multicrop drill. It will also be worthwhile to explore the possibilities to combine in the drill, the intercultural appliances with suitable modifications and attempt to make it a multipurpose drill. Work on the development of suitable bullock drill also needs to be continued.

Bullock drill.—A bullock-drill was evolved by the Agricultural Engineer, U.P. in 1951. This drill, though costly, proved to be of some promise. Certain modifications were suggested and these have of late been incorporated in the drill. Six such drills are now under trials in the different jute-growing States.

3. Manurial Trial

(*a*) To study the effects of nitrogen, potash and phosphorus and their combinations on jute, two trials, one with *capsularis* and the other with *olitorius* were carried out at the Chinsurah farm.

The treatments included three levels of nitrogen (0 lb., 20 lbs. and 40 lbs. of nitrogen per acre), two of potash (0 lb. and 25 lbs. K_2O per acre) and two of phosphates (0 lb. and 40 lbs. P_2O_5 per acre) and combinations thereof, in both the trials in replicated randomized layout in 4. replications.

The data on yield, cost of cultivation, cost of fertiliser and profit values obtained are given in Table XVIA and XVIB.

TABLE XVIA.

C. capsularis (*D154*)

Layout—Replicated randomised layout in 4 replications.

Effective plot size—0·0147 acre.

Sown on 26-5-51 and harvested on 1-10-51.

Treatments	Fibre yield		Cost of fertilisers per acre (Rs)	Value of produce per acre @ Rs. 50/- per maund (Rs)	Cost of cultivation (including fertiliser) per acre (Rs.)	Profit	
	Per acre (Mds)	Per-cent on control				Per acre (Rs)	Per-cent on control
$N_2P_1K_1$	**26·03	209·91	85·6	1301·50	427·15	874·35	245·88
$N_2P_0K_0$	**25·38	204·67	38·8	1269 00	377·10	891·90	250·82
$N_2P_0K_1$	**25·18	203·06	46·6	1259·00	383·90	875·10	246·09
$N_2P_1K_0$	**22·92	184·84	77·8	1146·00	399·80	746·20	209·84
$N_1P_0K_0$	*20·52	165·48	19·4	1026·00	329·40	696·60	195·89
$N_1P_1K_0$	*20·50	165·32	58·4	1025·00	368·30	656·70	184·67
$N_1P_1K_1$	18·30	147·58	66·2	915·00	363·10	551·90	155·20
$N_1P_0K_1$	18·07	145·72	27·2	903·50	322·95	580·55	163·27
$N_0P_1K_1$	14·72	118·70	46·8	736·00	324·80	411·20	115·64
$N_0P_1K_0$	14·57	117·50	39·0	728·50	316·25	412·25	115·93
$N_0P_0K_1$	13·70	110·48	7·8	685·00	279·70	405·30	113·99
$N_0P_0K_0$ (No manure)	12·40	100·00	...	620·00	264·40	355·60	100·00

P	0.01
S.E.%	11.20
C.D. at 1%	8.64 mds.
C.D. at 5%	6.1 mds.

N_1 — 20 lbs. nitrogen from Ammonium sulphate per acre

N_2 — 40 lbs. ,, ,, ,, ,, ,, ,,

K_1 — 25 lbs. K_2O from Muriate of Potash per acre

P_1 — 40 lbs. P_2O_5 from Super Phosphate (single) per acre

** Significant at 1% over control. (No manure)

* Significant at 5% over control. (No manure)

TABLE—XVI B.

C. olitorius (C. G.)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0. 011 acre.
Sown on 28-5-51 harvested on 15-9-51.

Treatments	Fibre yield		Cost of fertilisers per acre (Rs.)	Value of produce per acre @ Rs. 50/- per md. (Rs.)	Cost of cultivation (including fertiliser) per acre (Rs.)	Profit	
	Per acre (Mds.)	Per-cent on control				Per-acre (Rs.)	Per-cent on con-trol
$N_2P_1K_1$	**17·29	124·41	85·6	864·50	377·45	487·05	115·51
$N_2P_1K_0$	**17·78	127·94	77·8	889·00	373·10	515·90	122·35
$N_2P_0K_1$	**17·57	126·48	46·6	878·50	339·85	538·65	127·75
$N_2P_0K_0$	**18·10	130·27	38·8	905·00	335·70	569·30	135·02
$N_1P_1K_1$	15·34	110·37	66·2	767·00	347·30	419·70	99·54
$N_1P_1K_0$	14·88	107·13	58·4	744·00	337·20	406·80	96·48
$N_1P_0K_1$	*16·73	120·43	27·2	836·50	316·30	520·20	123·37
$N_1P_0K_0$	15·98	115·03	19·4	799·00	303·70	495·30	117·47
$N_0P_1K_1$	13·84	99·62	46·8	692·00	319·40	372·60	88·37
$N_0P_1K_0$	12·72	91·54	39·0	636·00	306·00	330·00	78·26
$N_0P_0K_1$	14·73	106·03	7·8	736·50	385·85	450·65	106·88
$N_0P_0K_0$ (No manure)	13·89	100·00	...	694·50	272·85	421·65	100·00

P 0.01
S.E.% 5.20
C.D. at 0.01% — 3.26 mds.
C.D. at 0.05% — 2.60 mds.
N_1 — 20 lbs. nitrogen from Ammonium sulphate per acre
N_2 — 40 lbs ,, ,, ,, ,, ,, ,,
K_1 — 25 lbs. K_2O from Muriate of Potash per acre
P_1 — 40 lbs. P_2O_5 from Super Phosphate (single) per acre
** Significant at 1% over control. (No manure)
* Significant at 5% over control. (No manure)

In the *capsularis* trial with 40 lbs of nitrogen the yield has increased by 84 to 109% over the control, being significant at 1% level. With 20 lbs of nitrogen the yield has increased by 45 to 65% over control being significant at or near 5% level. The increase in yield was due mainly to nitrogen. Highest profit was obtained in treatment $N_2 P_0 K_0$ (40 lbs. nitrogen level) and $N_1 P_0 K_0$ (20 lbs. N level). It would therefore seem that only nitrogen manuring would be found useful and economical in jute.

In the *olitorius* trial the significant increase in yield at 1% level over control was obtained with applications of 40 lbs of nitrogen, the increase in yield being 24 to 30% over the control. Application of 20 lbs of nitrogen gave 7 to 20% higher yields but the increase was not significant, except in treatment $N_1 P_0 K_1$ only at 5% level. The increases were due mainly to nitrogen. Potash tended to improve the yield somewhat at lower levels of nitrogen.

From the above it would appear that increases due to applications of nitrogen were much higher in *capsularis* than in *olitorius*. Application of 40 lbs nitrogen gave higher yields than 20 lbs nitrogen though the differences were not significant.

Detailed studies were made on 10 random plants per plot in *capsularis* manurial trial. The data on plant height, base diameter, green weight, clean stem weight, leaves and branches weight, fibre weight, dry jute stick weight and fibre per cent are given in Table XVI C which recorded increases, in all, with nitrogen applications.

TABLE XVI (C)

Manurial Trial, Chinsurah 1951-1952

C. capsularis (D154)

Average height, Base diameter, Green weight, etc., per plant at harvest stage based on 10 random plants per plot or 40 plants per treatment.

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0·0148 acre
Sown on 26-5-51 and harvested on 1-10-51.

Treatments.	Average plant height. (inches)	Average plant Base diameter. (cms.)	Average Green wt. of whole plant. (gms. per plant)	Average clean stem wt. per plant (fibre producing portion of plant.)	Average Green wt. of leaves & branches (non-fibre producing portion per plant) (gms.)	Average fibre wt. per plant. (gms,)	Average dry jute stick wt. per plant. (gms.)	Fibre % on green wt. of whole plant.	Fibre percent on green weight of clean stem.
$N_2P_1K_1$ ...	105·9	2·05	256·9	198·1	57·8	16·30	35·4	6·3	8·23
$N_2P_1K_0$ ...	104·4	1·96	222·0	173·8	46·6	14·55	33·2	6.5	8·37
$N_2P_0K_1$ ...	103·0	2·07	245·1	191·2	52·8	15·67	35·4	6·3	8·20
$N_2P_0K_0$ ...	101·4	2·06	255 6	197·5	57·6	16·60	35·8	6·4	8·41
$N_1K_1P_1$ ...	97·0	1·84	187·9	145·6	42·9	12.35	26·8	6·5	8·48
$N_1P_1K_0$ ...	99·4	1·93	209·5	162·0	46·2	13·75	30·6	6·5	8·49
$N_1P_0K_1$ ...	93·9	1·82	179·3	140·0	37·9	11·30	25·3	6·3	8 07
$N_1P_0K_0$ ...	92·8	1·69	156·6	133·9	33·4	9·77	21·8	6·2	7·30
$N_0P_1K_1$ ...	88·6	1·69	141·5	108·2	32·2	9·17	19·8	6·6	8·48
$N_0P_1K_0$ ...	90·1	1·68	154·6	116·5	37·1	8·80	21·7	5·7	7·55
$N_0P_0K_1$ ...	87·5	1·80	164·1	124·6	39·0	9·42	22·8	5·7	7·56
$N_0P_0K_0$ (No manure) ...	82·8	1·58	118·8	90·7	26·7	6·85	15·9	5·7	7·55

N_1 = 20 lbs nitrogen from ammonium sulphate per acre
N_2 = 40 lbs " " " " "
K_1 = 25 lbs K_2O from muriate of potash per acre
P_1 = 40 lbs P_2O_5 from super phosphate (Single) per acre.

(b) Effect of Organic and Inorganic Nitrogen on Jute.—

To study the effects of organic and inorganic sources of nitrogen and their combinations on the yield of jute, two trials one with *capsularis* and the other with *olitorius* were carried out at Chinsurah farm. For inorganic source of nitrogen, Ammonium sulphate (20% N) at 100% availability basis was used and for organic source a mixture (giving equal quantities of nitrogen) of Town Compost (1.01% nitrogen) and F.Y.M. (0.51% nitrogen) at 50% availability basis was used. The treatments included applications of 30 lbs. of nitrogen per acre from combination of 100, 67, 33 and 0% of inorganic and organic sources respectively. The treatment of no manure was also included as control. Application of Ammonium sulphate was made in 2 equal instalments, the first half was applied just before sowing and the second half as a top dressing on 42 days old, in case of *capsularis* and 40 days old crop, in *olitorius*, respectively. The data on yield, cost of manure and profit per acre are given in Tables XVII A and XVII B.

TABLE XVIIA.

C. capsularis (*D154*)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0·0047 acre.
Sown on 25-5-51 and harvested on 6-10-51.

Treatments	Fibre yield		Cost of manure	Value of produce @ Rs. 50/- per md.	Cost of cultivation (with manure)
	Per acre (mds.)	Percent on control	(Rs.)	(Rs.)	(Rs.)
(E) 100% inorganic N + 0% organic N ...	20·26	136·43	29·1	1013·00	333·50
(D) 67% inorganic N + 33% organic N ...	19·92	134·14	29·3	996·09	332·30
(B) 50% inorganic N + 50% organic N ...	18·62	125·39	29·5	931·00	325·50
(C) 33% inorganic N + 67% organic N ...	16·98	114·34	26·60	849·00	316·00
(A) No manure (control) ...	14·85	100·00	nil	742·50	277·00
(F) 0% inorganic N + 100% organic N ...	14·17	95·42	30·00	708·50	273·00

P	0·01
S·E.%	5·05
C.D. at 1%	3·68
C.D. at 5%	2·62

TABLE XVIIB.

C. olitorius (*C. G.*)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0·0065 acre.
Sown on 27-5-51 and harvesied on 20-9-51.

Treatments	Fibre yield		Cost of manure	Value of produce @ Rs. 50/- per md.	Cost of cultivation (with manure
	Per acre (mds.)	Percent on control	(Rs.)	(Rs.)	(Rs.)
(D) 67% inorganic N + 33% organic N ...	35·71	114·95	29·30	1785·50	405·30
(B) 50% inorganic N + 50% organic N ...	35·57	114·48	29·50	1778·50	404·60
(C) 33% inorganic N + 67% organic N ...	34·71	111·72	26·60	1735·50	398·10
(F) 0% inorganic N + 100% organic N ...	33·45	107·65	30·00	1672·50	395·50
(E) 100% inorganic N + 0% organic N ...	32·20	103·63	29·10	1610·00	388·10
(A) No manure (control) ...	31·07	100·00	nil	1553·50	351·20
P	Large				
S.E.%	4·18				

In the *capsularis* trial significantly higher yields were obtained by increasing the proportion of nitrogen from inorganic sources. There has, however, been no response to nitrogen when the whole of it has been added from organic sources. In the *olitorius* trial no significant differences were found. The trial was conducted in a piece of land in which the level of fertility was rather high due to heavy basal dressings with town compost in the previous years which perhaps suppressed the responses.

(*c*) *Application of fertilisers in instalments.*—To find out the yield effects of time of application of Ammonium sulphate to jute, two trials, one with *capsularis* and the other with *olitorius* were carried out. The treatments included applications at different times (before sowing, at 1st weeding and at 2nd weeding) of a total quantity of 30 lbs of nitrogen per acre from Ammonium sulphate. The data on yield and fibre per cent are presented in Tables XVIIIA and XVIIIB.

No significant yield differences due to various times of applications of Ammonium sulphate were noticed in either of the trials during the year under report.

TABLE XVIIIA

C. capsularis (D154)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0.0102 acre.
Sown on 5.6.51 and harvested on 11.10.51.

Treatments	Fibre weight	
	Per acre (Mds.)	Per cent on control
A. Control (No manure) ...	24.05	100.00
B. 30 lbs N per acre before sowing	26.79	111.40
C. 10 lbs N per acre before sowing and 20 lbs N per acre after 1st weeding ...	26.42	109.86
D. 10 lbs N per acre before sowing plus 10 lbs N after 1st weeding plus 10 lbs N after 2nd weeding ...	27.40	113.94
E. 0 lb N per acre before sowing plus 30 lbs N after 1st weeding plus 0 lb N after 2nd weeding	29.46	122.51
F. 0 lb N per acre before sowing plus 30 lbs N after 1st weeding plus 30 lbs N after second weeding ...	25.69	106.80
G. 10 lbs N per acre before sowing plus 0 lb N after 1st weeding plus 20 lbs N after 2nd weeding	26.90	111.87
H. 0 lb N per acre before sowing plus 20 lbs N after 1st sowing plus 20 lbs N after 2nd weeding	28.74	119.49
P		Large
S.E.%		4.64

TABLE XVIIIB

C. olitorius (C.G.)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0.0102 acre.
Sown on 5.6.51 and harvested on 15.10.51.

Treatments	Fibre weight	
	Per acre (Mds.)	Per cent on control
A. Control (No manure) ...	22.55	100.00
B. 30 lbs N per acre before sowing	24.02	106.47
C. 10 lbs N per acre before sowing and 20 lbs N per acre after 1st weeding ...	25.99	110.78
D. 10 lbs N per acre before sowing plus 10 lbs N after 1st weeding plus 10 lbs N after 2nd weeding ...	24.05	109.37
E. 0 lb N per acre before sowing plus 30 lbs N after 1st weeding plus 0 lb N after 2nd weeding ...	25.01	110.86
F. 0 lb N per acre before showing plus 0 lb N after 1st weeding plus 30 lbs N after 2nd weeding ...	28.74	119.49
G. 10 lbs N per acre before sowing plus 0 lb N after 1st weeding plus 20 lbs N after 2nd weeding ...	23.35	103.52
H. 0 lb N per acre before sowing plus 20 lbs N after 1st weeding and 10 lbs N after 2nd weeding ...	24.94	110.54
P		Large
S.E.%		3.680

(*d*) *Comparative merits of inorganic nitrogenous fertilisers on jute.*—To study the comparative merits of inorganic nitrogen fertilisers on yield and quality of fibre two trials, one with *capsularis* and other with *olitorius* were carried out. The fertilisers used were Ammonium sulphate, Potassium nitrate, Ammonium nitrate and Sodium nitrate. The data on fibre yield are presented in Tables XIXA and XIXB.

TABLE XIXA.

C. capsularis (*D154*)

Layout—Replicated randomised layout in 4 replications.

Effective plot size—0·00303 acre.

Sown on 25.5.51 and harvested on 12.10.51.

Treatments	Fibre yield		Cost of fertiliser per acre (Rs.)
	Per acre (Mds.)	Percent on control	
1. Ammonium sulphate @ 30 lb N per acre ...	19·56	100·00	29·10
2. Potassium nitrate @ 30 lbs N per acre	17·99	91·98	67·03
3. Ammonium nitrate @ 30 lbs N per acre ...	17·61	90·05	18·55
4. Sodium nitrate @ 30 lbs N per acre ...	17·55	89·71	39·00

P ... ... Large

S. E.% ... ... 5·91

TABLE—XIXB.

C. Olitorius (*C. G.*)

Layout—Replicated randomised layout in 4 replications.
Effective plot size—0·00303 acre.
Sown on 25·5·51 and harvested on 12.10.51.

Treatments	Fibre yield		Cost of fertiliser per acre (Rs).
	Per acre (Mds.).	Percent on control	
1. Ammonium sulphate @ 30 lbs N per acre ...	19·51	100·00	29·10
2. Potassium nitrate @ 30 lbs N per acre ...	19·34	99·12	67·03
3. Ammonium nitrate @ 30 lbs N per acre ...	18·81	96·39	18·55
4. Sodium nitrate @ 30 lbs N per acre ...	14·68	75·26	39·00
P		0·05	
S.E.%		5·40	
C. D.		3·10	

No significant yield differences were obtained in the *capsularis* trial, though Ammonium sulphate gave the best result. In the *olitorius* trial Sodium nitrate gave significantly less yield than the other three inorganic nitrogenous fertilisers. Here also, as in *capsularis*, Ammonium sulphate gave the best result, though the differences between Ammonium sulphate, Potassium nitrate and Ammonium nitrate were insignificant. From economic point of view it appears that Ammonium sulphate should be preferred as a source of inorganic nitrogen.

4. Double and Triple Cropping Experiments

(*a*) *Double cropping low lands with capsularis jute and Aman paddy.*—To study the possibilities of growing jute as an earlier additional crop in the low lands which are normally single cropped with Aman paddy, a trial was conducted with two varieties of jute—one early-Fanduk and the other late-D154, with 3 stages of harvest and one variety of paddy (deepwater) as second crop. Studies of soil exhaustion by chemical examination of the soil before and after each crop have been carried out in the Chemical Section.

The data of sowing and harvesting dates, yield, cost of cultivation and profit values for various treatments are given in Table XX.

TABLE XX.

Jute varieties—Fanduk (Early) and D154 (Late). Paddy variety—Tilakkachary
Layout—Replicated randomised layout in 4 replications
Effective plot size—0·0038 acre

Treatments			Jute 1st crop		Paddy 2nd crop		Total* profit per acre. (Rs.)	Sowing and harvest date of paddy and jute			
								1st crop jute		2nd crop paddy	
Jute variety	Stage of harvest of jute. (No. of days old crop)	Followed by 2nd. crop paddy.	Fibre yield per acre (Mds)	%yield on control (Jute alone)	Paddy grain yield per acre (Mds)	% yield on control (Paddy alone)		Date of sowing.	Date of harvest.	Date of trans-planting.	Date of harvest.
A. Fanduk ...	Pre-bud (98 days)	Paddy	8·74	44·09	22·14	101·9	307·7	2.4.51	9.7.51	10.7.51	4.12.51
B. Fanduk ...	Bud (108 days)	Paddy	13·31	67·15	22·08	101·6	511·2	2.4.51	19.7.51	21.7.51	4.12.51
C. Fanduk ...	Flower (128 days)	Paddy	16·08	81·13	20·94	96·4	623·6	2.4.51	7.8.51	10.8.51	4.12.51
D. D154 ...	Pre-bud (108 days)	Paddy	13·91	70·18	21·88	100·7	536·4	2.4.51	19.7.51	21.7.51	4.12.51
E. D154 ...	Bud (127 days)	Paddy	15.94	80 42	18·55	85·4	595·3	2.4.51	7.8.51	10.8.51	4.12.51
F. D154 ...	Flower (143 days)	Paddy	17.89	90·26	17·66	81·3	672·7	2.4.51	23.8.51	25.8.51	4.12.51
G. D154 (Control) ...	Pod (173 days)	Nil	19.82	100·00	Nil	Nil	682·6	2.4.51	20.9.51	Nil	Nil
H. Nil ...	Nil	Paddy (Control)	Nil	Nil	21·73	100·00	113·6	Nil	Nil	16.7.51	4.12.51

*Jute valued at Rs. 50/- per maund and paddy at Rs 10/- per maund.

For jute, later stages of harvest gave higher fibre yields. With Fanduk (early variety) the yields at pre-bud, bud and flower stages of harvest were 44.09, 67.15 and 81.13 per cent of control (D 154, pod stage harvest). With D 154 (late variety) the yields at pre-bud, bud and flower stages of harvest were 70.18, 80.42 and 90.26 per cent of control (D154, pod stage harvest).

Paddy yields in jute plots were highest where the land was released earliest (earlier stages of jute harvest). Where the 1st crop (jute did not occupy the land for more than 108 days), the yield of paddy as the second crop did not seem to suffer due to growing of jute as compared to plots under paddy alone. Beyond this period *i.e.* where paddy could be transplanted only later than 21.7.51 the paddy yields were repressed. This may be due more to late transplantation of paddy than to soil exhaustion by jute.

D 154, seemed to lower paddy yields more than Fanduk for the same period of growth, though the yields of fibre were similar. This would indicate that D 154 (late variety) perhaps exhausted the soil at a slightly higher rate than Fanduk (early variety).

Highest per acre profit was obtained from treatment G closely followed by F and C the main profit being from jute, as the value of jute fibre was very much more than paddy during the period under report. The data showed that if maintaining paddy yield be the objective in a double cropping programme, harvesting of jute should be done at pre-bud, bud and flower stages where Fanduk (early variety) is grown and pre-bud stage where D 154 (late variety) is grown.

(*b*) *Large scale trial of Double cropping low land.*—A large scale trial in 0.5 acre plots, was put in low land by the side of double cropping experimental trial plot. The treatments included only two plots of 0.5 acres, one of paddy alone and the other of jute (1st crop) and paddy (2nd crop). The data obtained

supported the results of the previous experiment. Jute was sown on 3rd April 1951 and harvested on 27th July 1951 and the yield was 15.5 maunds per acre. Paddy was transplanted on 1st August 1951 in both the plots. The yield from the second crop paddy was 16.1 maunds per acre, whereas that from the single cropped paddy was 17.1 maunds per acre.

It would, therefore, be evident that profit obtained by double cropping the land with jute and paddy was very much higher than by single cropping the land with paddy alone.

The year under report was not favourable for paddy at Hooghly due to lack of sufficient and timely rains. Most of the paddy crop grown in other areas of the firm had to be irrigated several times. In the cultivators' plots, much of the area could not be transplanted at all and whatever was transplanted gave poor yields. Vast stretches of cultivators' land all round the farm where only one crop of transplanted Aman paddy is normally grown remained uncropped. It would thus be seen that growing of jute as the first crop in such lands would have ensured the cultivators of some returns instead of "no-return" at all, in a year like this. His paddy yields, if grown, also would not have suffered much due to growing of jute as the first crop, provided the paddy was transplanted in time. Even in normal paddy year suppression of paddy yields if any, due to jute cropping can perhaps be easily be made up by application of some manure to paddy. Jute unlike other crops, will give some yield whenever harvested which can always be done at any stage of crop growth to suit the timely transplanting of paddy. In this respect, jute has particular and specific advantages over most other crops in a double cropping programme.

(*c*) *Triple cropping mid-lands with capsularis jute, aman paddy and pulses.*—The treatments included two varieties of jute—one early (Fanduk) and the other, late (D 154); two stages of harvest (early and late) of jute and two varieties of paddy (as second crop) one early (Badkalamkati) and one late (Patnai). The third crop consisted of khesari sown in standing paddy crop when soil moisture conditions permitted

and gram sown after paddy harvest. Treatments of jute and paddy alone as control were also included. Due to water-logging from seepage and leakage water from adjoining irrigation chennels the khesari crop yields were poor and the gram crop completely failed. The trial thus can be considered as double cropping rather than triple cropping.

The data on yield, cost of productions value of produce, profits and dates of sowing and harvesting of each crop are given in Table XXI. The costs of production and profit from the 3rd crop has been enclosed in calculations.

Higher fibre yields were obtained from later stages of jute harvests. For the same period of growth, irrespective of stage of maturity, D154 (a late variety) gave higher fibre fields than Fanduk (an early variety). In paddy the date of transplanting within certain limits was found to be more important, earlier transplantings giving higher yields. Profits obtained were mainly from jute.

Studies of chemical examination of soil before and after each crop were carried out to find out the extent of soil exhaustion in the various cropping sequences.

(*d*) *Triple cropping high-mid-lands with olitorius jute, aman paddy and pulses.*—The treatments included 2 stages of harvest (early and late) of jute (1st crop), two manurial treatments *i.e.* unmanured and manured with town compost before jute at the rate of 30 lbs nitrogen per acre, 2 varieties of paddy as second crop (early and late) following jute; khesari and gram as third crop following paddy. Two treatments of jute and paddy alone plots were also included as control. The year was not satisfactory for paddy, the yields of which was poor. Khesari as the third crop was sown when paddy was standing. Gram sown after harvest of paddy entirely failed due to lack of sufficient rain or irrigation facilities. Cost of cultivation and profits from these were not included in the calculations. The data on yields and profit values for the first two crops are given in Table XXII.

TABLE XXI

Triple cropping mid-lands with *capsularis* jute, aman paddy and pulses (1951-52)
Yield, cost of production, value of produce and profit per acre
Layout—Replicated randomised blocks in 4 replications
Effective plot size—0·0146 acre
Date of sowing of jute—11-5-51. Date of sowing khesari—6-11-51

Variety	1st crop jute	2nd crop paddy	1st crop jute	2nd crop paddy		1st and 2nd crop jute and paddy		
	Stage of harvest of jute. (No. of days old crop with dates.)	Variety (With dates of transplanting)	Jute fibre yield per acre (Mds.)	Paddy grain yield per acre (With dates of harvest)	Yield of straw per acre (Mds.)	Gross value of produce per acre (Rs.) **	Gross cost of cultivation per acre (Rs.)	Net profit per acre. (Rs.)
A. Fanduk ...	Early (85 days) 4-8-51	Badkalamkathi (Early) 9-8-51	13·31	18·38 21-11-51	27·15	917·18	385·0	532·18
B. Fanduk ...	-do-	Patnai (Late) 9-8-51	14·31	24·22 4-12-51	26·96	1050·10	394·8	558·50
C. Fanduk ...	Late (109 days) 28-8-51	Badkalamkathi (Early) 30-8-51	18·71	16·91 21-11-51	24·22	1165·15	409·1	756·05
D. Fanduk ...	-do-	Patnai (Late) 30-8-51	17·81	21·51 4-12-51	33·41	1189·13	411·0	778·13
E. D154 ...	Early (102 days) 21-8-51	Badkalamkathi (Early) 23-8-51	21·47	16·71 21-11-51	24·85	1302·73	426·2	876·53
F. D154 ...	-do-	Patnai (Late) 23-8-51	20·06	22·55 4-12-51	32·57	1309·93	425·8	884·13
G. D154 ...	Late (119 days) 7-9-51	Badkalamkathi (Early) 9-9-51	24·11	16·50 21-11-51	21·93	1425·33	441·3	984·03
H. D154 ...	Late (119 days) 7-10-51	Patnai (Late) 9-9-51	22·73	18·58 4-12-51	29 65	1396·43	442·2	954·23
I. D154 ...	Pod (Control) (149 days)	nil	25·99	nil	nil	1299·50	343·4	956·10
J. Nil ...	nil	Patnai (Late) (Control) 9-8-51	nil	25·68 4-12-51	42·18	362·25	120·0	242·25

**Jute sold at Rs. 50/- per maund and paddy grain at Rs. 10/- per maund and straw at Rs. 2/8/0 per maund.

TABLE XXII

Triple cropping high lands with *olitorius* Jute, aman paddy and pulses.
Yield, cost of production, value of produce and profit per acre.
Layout—Replicated randomised blocks in 4 replications.
Effective plot size—0.0113 acre.
Date of sowing of jute—17.5.51. Date of sowing of khesari—1.12.51

	1st crop jute	2nd crop paddy	1st crop jute	2nd crop paddy		1st and 2nd crop jute and paddy			
Variety	Stage of harvest of jute. (No. of days old crop with dates)	Variety (With dates of transplanting)	Jute fibre yield per acre (Mds.)	Paddy grain yield per acre (With dates of harvest)	Yield of straw per acre (Md.)	Gross value of produce per acre (Rs) **	Gross cost of cultivation per acre (Rs.)	Net profit per acre (Rs.)	Yield of khesari per acre (Mds.)
A. C. G. Manured	Early(89days) 14.8.51	Badkalamkathi (Early) 16.8.51	17·80	12·07 10.11.51	25·0	1077·20	402·4	674·80	6·26
B. C. G. Unmanured	—do—	—do—	16·10	11·67 10.11.51	22·8	978·70	371·6	599·10	6·50
C. C G. Manured	—do—	Patnai (Late) 16.8.51	17·70	11·67 23.11.51	27·9	1071·45	401·3	670·15	7·27
D. C. G. Unmanured	—do—	—do—	16·11	11·54 23.11.51	26·6	987·40	571·4	616·00	4·86
E. C. G. Manured	Late(107days) 1.9.51	Badkalamkathi (Early) 3.9.51	25·45	11·80 14.11 51	25·0	1453·00	445·2	1007·80	8·21
F. C. G. Unmanured	—do—	—do—	25·26	11·00 14.11.51	24·4	1434·00	423·5	1010·20	4·79
G. C. G. Manured	—do—	Patnai (Late) 3.9.51	25·66	11·30 23.11.51	25·5	1459·75	444·5	1015·25	5 52
H. C. G. Unmanured	—do—	—do—	24·55	10·46 23.11.51	24·4	1393·10	422·8	975·30	4·93
I. Jute Single (Control)	139 days (Pod stage) 3.10.51	—	29·67		—	1483·50	352·8	1130·70	—
J. PaddySingle (Control)	nil	Patnai (Late) 16.8.51	—	13·01 23.11.51	28·3	200·85	90.0	110·85	—

** Jute sold at Rs. 50/- per maund, paddy at Rs. 10/- per maund and straw at 2/8/0 per maund.

Jute yields increased with later stages of harvest. Manured plots gave slightly higher jute yields than unmanured plots but the difference was not significant. Profits were mainly from jute. Jute alone and treatments G.F.E. and H gave high profit values.

5. Manurial Trials in Cultivators Plots at Jute Growing States:

Based on results obtained from the experiments conducted at Jute Agricultural Research Institute of positive response of jute yields to nitrogen applications, a scheme on manurial trials in the various jute growing states was prepared and approved for the first time by the I.C.J.C. in 1951-52. The object was to ascertain responses from Ammonium sulphate under varying soil and climatic conditions.

Two schemes of trial were drawn up, one for zones where soils were known to be neutral or slightly alkaline and the other zone where soils were reported or expected to be somewhat acidic.

The treatments in the trial for acid zone were as follows:— (A) No manure (control), (B) 20 lbs N from Ammonium sulphate per acre, (C) 3 maunds lime per acre and 20 lbs N from Ammonium sulphate per acre, (D) 6 maunds lime and 20 lbs N from Ammonium sulphate, (E) 3 maunds lime alone per acre, (F) 6 maunds lime alone per acre.

The treatments for the non-acid zone trials were as follows:—(A) No manure (control), (B) 20 lbs N from Ammonium sulphate per acre, (C) 40 lbs N from Ammonium sulphate per acre.

The following trials were originally proposed and actually conducted during 1951-52 jute season;—

States	No. of trials originally proposed in 1951-52		No. of trials actually conducted in 1951-52.	
	Non-acid zone	Acid zone	Non-acid zone	Acid zone
Bihar ...	50	34	50	20
W. Bengal ...	20	nil	14	nil
Orissa ...	12	nil	8	nil
Assam ...	8	8	nil	nil
U. P. ...	6	nil	6	nil
Total	96	42	78	20
Total trials	138		98	

Bihar (A)—In non-acid soils nitrogen both at 20 and 40 lbs level generally increased the yield in all the districts. The increases were very much higher in some places than others. Higher doses of N (*i.e.* 40 lbs.) did not increase the yield over 20 lbs. nitrogen in some cases.

(B) Acid soils—In acid soils the responses have been somewhat inconsistent. The yield increased with lime and nitrogen when applied singly or in combination. Lime alone, in many places seemed to have increased the yield more than nitrogen alone or nitrogen plus lime. These peculiarities in the results obtained in the acid soil only require more detailed study.

West Bengal.—In general responses due to nitrogen has been positive, both at 20 and 40 lbs N per acre increasing the yield. Often 40 lbs N per acre have not appreciably increased the yield over 20 lbs. N.

Orissa.—The response due to nitrogen applications were positive and the yield increased both at 20 lbs and 40 lbs nitrogen levels.

U.P.—Here also response to nitrogen applications were similar to other States.

Assam.—Sixteen trials originally scheduled for the State could not be carried out during the year under report.

It has been noted from the results that nitrogen applications both at levels of 20 lbs and 40 lbs nitrogen per acre increased the jute fibre yields considerably in all the jute growing areas. The range of increases varied widely from place to place.

6. Date of Sowing in Jute:

To study the effects of dates of sowing on plant growth and yield of fibre, two trials with *capsularis* and *olitorius* respectively were carried out. The treatments included in *capsularis*, eight different dates of sowing commencing from 16th March at intervals of 15 days between the sowings. For *olitorius* the treatments included 6 dates of sowings at intervals of 15 days commencing from 1st April, 1951. The data on yield are given in Tables XXIIIA and XXIIIB for *capsularis* and *olitorius* respectively.

Satisfactory *capsularis* yields were obtained with sowings between 16th March to 1st May. 1st May sowing give significantly higher yields.

In the *olitorius* trial sowings between 15th April and 16th May gave significantly higher yields to other sowings. Sowings later than 16th May or earlier than 16th April gave poorer yields. In *olitorius* the rate of decrease in yield due to sowings later than 16th May and up to 15th June, was less than that of *capsularis*.

TABLE XXIIIA

C. capsularis (D154)

Effect on dates of sowing on plant growth, flowering and yield (1951-52)

Layout—Replicated randomised layout in 6 replications.

Effective plot size—0·0022 acre.

Treatments	Date of sowing	Date of harvest	Yield per acre (Mds.)
A. 16th March ...	16·3·51	20·8·51	18·2
B. 1st April ...	1.4.51	29·8·51	20·2
C. 16th April ...	16.4.51	29·8·51	21·2
D. 1st May ...	1.5.51	21·9·51	26·5
E. 16th May ...	16·5·51	21·9·51	15·1
F. 1st June ...	1·6·51	3·10·51	11·1
G. 16th June .	16·6·51	18·10·51	6·7
H. 1st July ...	1·7·51	2·11·51	2·8
P	...	...	0·01
S. E. %	...	...	8·2
C. D.	...	...	4·80

TABLE XXIIIB

C. olitorius (*C. G.*)

Effect on dates of sowing on plant growth, flowering and yield (1951-52)

Layout—Replicated randomised layout in 4 replications.

Effective plot size—0.0032 acre.

Treatments	Date of sowing	Date of harvest	Yield per acre (Mds.)
A. 1st April ...	1·4·51	11·8·51	13·76
B. 16th April ...	16·4 51	6·9·51	24·97
C. 1st May ...	1·5·51	26·10·51	22·47
D. 16th May ...	16·5·51	26·10·51	20·91
E. 31st May ...	31·5·51	26·10·51	16·24
F. 15th June ...	15·6·51	26·10·51	15·84
P	...	...	0·01
S. E. %	...	...	8·13
C. D.	...	...	6·45

VI. SOIL AND BIOCHEMICAL STUDIES

1. RETTING OF JUTE:

The work on retting was principally done with a view to shorten the retting period. Attempts were also made for the isolation of specific bacteria and other organisms responsible for the retting process.

(*a*) *Effect of activators on retting*.—For shortening the period of retting, and fixing proper doses of activators nine different experiments were carried out with different treatments. The work to find out exact ratio of N:P:K under optimum condition of retting as also analyses of the retting water could not be done for the failure of the gas plant, shortage of staff and non-availability of a Beckman or Muirhead type pH meter.

The following chemicals were used in different concentrations.—tribasic calcium phosphate, dibasic potassium phosphate, ammonium sulphate, ammonium oxalate, dibasic ammonium phosphate, calcium carbonate, monobasic potassium phosphate, sodium oxalate, calcium nitrate, potassium nitrate. In addition to these, bone dust and gelatine were also used in different doses. From the experiments carried out it has been found that addition of some of these substances singly and in combination reduces retting period, whilst in the case of some others, the period has increased. Generally speaking bone dust and Ammonium sulphate when added singly or in combination have reduced the retting period considerably, while nitrates generally increased it. This corroborates also last year's results. Bone dust and Ammonium sulphate in combination reduced retting period more than when added singly. Retting period has decreased progressively with the increase in the concentration of bone dust up to 1 gm per 500 c.c. of retting water. Further increase in the concentration up to 5 gms. per 500 c.c. did not show any marked variation. Gelatine has a negative effect. From this it may be stated that the efficacy of Bone dust is apparently due to its nitrogen and phosphate contents. The experiment to find out the optimum proportion of Bone dust and Ammonium sulphate for the best advantage has been planned and the work will be started with the next season's samples.

In an attempt to know which of the ions—ammonium or oxalate—in ammonium oxalate is responsible for reducing the retting period, an experiment was carried out. It has been found that though ammonium oxalate has been very much effective in several cases, sodium oxalate has either not been effective or effective to a very little degree showing thereby ammonium ion of ammonium oxalate plays the role and the oxalate ion not so much though it may have a solubilising effect on the pectins and gums.

No marked difference was found in the period of retting in one of the experiments possibly because the stems were very thin. A fresh charge was given in the same series of flasks without any further addition of chemicals. The retting period was the least in the flasks where bone dust was added.

To find out which of the conditions—anaerobic, aerobic or partially aerobic—is effective for retting, a preliminary experiment was carried out. It was found that aneorabic condition from the very beginning was not suitable for retting even though the water used contained a considerable number of retting organisms. A detailed work has been planned for this season.

(*b*) *Microbiological* :—

(*i*) *Isolation of organisms and study of their properties.*—The work on the isolation of organisms responsible for retting was continued. Several aerobic and micro-aerophyllic bacteria and 3 fungi have been isolated in pure condition from retting water obtained from Chinsurah.

(*ii*) *Microbial survey of retting water.*—A preliminary microbial survey of setting water has been started from retting water of five different places. The work is in progress.

(*iii*) *Effect of pectinases on retting.*—Pectinases obtained from guava pectins have been tried for retting. No positive results were obtained. The work will be continued in the next season.

2. Analysis of Soils and Manures for their Chemical and Mechanical Constituents :

(*a*) *Routine analyses.*—(*i*) Routine analyses of miscellaneous samples, fertilisers and manures were done as and when re-

quired. (*ii*) A preliminary study on moisture percentage of soils suitable for agricultural operations were carried out at Chinsurah.

(*b*) *Soil survey.*—Samples from Balakoba, Nowgong and Kendrapara areas were collected. Their available plant nutrients have been determined. Further work is in progress. It is proposed to have a survey of surface samples this year from areas near about our farm at Barrackpore.

3. Soil Exhaustion Studies:

(*a*) *Soil exhaustion by double and triple cropping.*—The work on the study of the amount of exhaustion of soils in double and triple cropped lands was carried out in collaboration with the Agronomy Section.

In samples of 1951-52 season total nitrogen, available phosphate (by seminormal acetic acid method), Organic carbon (by wet combustion method) were determined in the sample drawn before, during and after jute stages in each of the 62 treatments. It was found that there was no regularity of change of total nitrogen and available plant nutrients. The variations had been to a very small degree which may possibly be due to the microbial activity in the soil. A detailed analysis would be carried out in the samples of 1952-53 season to test whether any of the soil constituents change markedly due to growing jute. For this besides double and triple cropping experiments carried out by the Agronomy Section, other experiments have also been planned.

The last two years' experiments were carried out at Chinsurah farm, where the soil is heavy clay, rich in calcium and phosphate and the pH of the plots before jute varied between 6.4 - 6.8 (by Colorimetric method), and where preliminary determinations showed the presence of a large number of nitrogen fixing organisms, and their rise during the growth of jute. Our observation *i.e.* the soil is exhausted, if at all, to a very small degree with cropping of jute for one year only is to be restricted to Chinsurah conditions.

(*b*) *Soil exhaustion in Manurial trial plots.*—(*i*) *Agronomic Manurial trial plots.*—Soil samples obtained before jute and after jute from the manurial plots of 1950-51 season were

analysed for total N, organic carbon (by Wet Combustion method) exchangeable K. and Ca (by Williams' method) and available P (by Semi-normal acetic acid method). The findings are the same as those in double and triple cropping plots, that is, the variation has been very little or none. Analyses of samples of 1951-52 season after jute are in progress.

(*ii*) *Changes in the soil due to heavy inorganic fertilisation.*—In an attempt to find out the maximum possible yield of jute, nitrogen was added from 0 to 320 lbs. N as a mixture containing 50% ammonium sulphate and 50% sodium nitrate. Additions of large doses of other cations are likely to have an effect on exchangeable calcium by removing it and thereby lower pH. Ammonium ion and sodium ion both affects organic matter either decomposing it or solubilising it. Available P is also likely to vary. After harvest of jute, available P (Semi-normal Acetic acid method), Exchangeable Ca (by Williams' method), Organic carbon (by Wet Combustion method) and pH by Colorimetric method were determined. The data are presented in the following table.

TABLE XXIX

Showing the effect of very high doses of nitrogen from both ammonium sulphate and sodium nitrate in equal proportion.

Material	Treatment	% Org. C (W.B. value)	pH	p.p.m. available P	Exchangeable Ca in mgm. CaO/ 100 gm soil
Capsularis (D154)	0 lb. N/acre	·75	7·0	11·5	413
	40 lb. N/acre	·75	6·8	15·3	298
	80 lb. N/acre	·73	6·8	13·5	444
	160 lb. N/acre	·60	6·8	12·6	329
	240 lb. N/acre	·57	6·8	10 7	400
	320 lb. N/acre	·39	6·7	10·1	226
Olitorius (C.G)	0 lb. N/acre	·73	7·0	7·9	240
	40 lb. N/acre	·73	6·9	9·3	240
	80 lb. N/acre	·73	6·8	11·5	222
	160 lb. N/acre	·65	6·8	12·5	302
	240 lb. N/acre	·65	6·4	8·8	218
	320 lb. N/acre	·62	6·2	8·2	311

From the above table, it may be seen that the trend of the organic matter and pH has been towards a gradual fall with the increase in the addition of ammonium sulphate and sodium nitrate. Available P has first risen and then fallen which is quite possible.

(*iii*) *Transformation of soil phosphates, under the influence of different fertilisers and manures at Chinsurah.*—This work was done with samples drawn from manurial trial plots of the Agronomy Section. The work on *C. capsularis* plots of 1950-51 season has been completed. The work on *C. olitorius* plots of 1950-51 season is in progress. The findings of 1950-51-*capsularis* plots may be summarised as follows:—

Available phosphate (by Williams' method) have decreased in all cases. Alkali-soluable inorganic phosphates, alkali-soluble organic phosphates and 2N sulphuric acid soluble phosphates have increased generally showing thereby that cropping with jute has a beneficial effect on the soil from the phosphate requirement point of the subsequent crops as organic and difficulty soluble phosphates are available to plants under Indian conditions. Application of Potassium alone or with single doses of nitrogen have behaved a little differently so far soil-phosphates are concerned. The fall in available phosphates has been very marked and also there has been a fall in the organic phosphatic compounds content in contrast with other treatments.

(*iv*) *Fixation of phosphates in plots fertilised with phosphatic fertilisers.*—This study was made from samples obtained periodically from phosphate treated plots of the manurial trial plots of the Agronomy Section of 1951-52 season.

Available P has gradually decreased generally in case of *capsularis* plots and increased in *olitorius* plots. The quantity of organic alkali soluble P gradually rises in case of *capsularis* as also somewhat in *olitorius*, but after three months' time, organic P is more in the control than in the P-treated plots. This is pronounced in the case of *olitorius* plots. Inorganic alkali soluble P gradually increases but in case of *capsularis* plots it is less than the control and in case of *olitorius* plots, this quantity is much more than the control. Fluctuation of 2N sulphuric acid soluble phosphate is irregular.

It may be generally concluded that application of moderate amounts of P for jute has no additional beneficial effect for the subsequent crops under Chinsurah conditions.

(*v*) *Transformation of phosphates under the influence of selenates.*—Various substances which are ordinarily poisonous in small doses often stimulate the activities of the micro-organisms. In a preliminary study by the Entomology Section on the effects of selenates as an antidote to pests of jute, it was thought that interesting results may be obtained by studying phosphate fractions of the soil after treatment with selenates as this may have an effect on the soil micro-organisms.

The organic phosphorus content increased considerably in single dose treatment (5 p.p.m. Se) but at higher doses, it decreased considerably when Selenium has been added singly or in combination with other salts except in the case of calcium sulphate, where this increase has been marked in the case of 10 p.p.m. Selenium treatment. This is probably due to the higher absorption by the plant of Se and residual being less. This gives an indirect evidence that in small doses Selenates excites the microbial activity of the soil.

4. Withdrawal of Nutrients by the Plant

(*a*) *Accumulation of inorganic P. K. and Ca in the plant-under manurial treatments.*—Analyses of plant materials obtained from the manurial trial plots of the Agronomy Section were done to develop diagnostic technique. Quantitative estimations of inorganic P, K and Ca were made in the tip leaves and the stem-tip at the pre-bud stage and at the harvest stage at the first and second 20 cm portions from the tip. Tip leaves and stems were cut into thin pieces with a sharp blade macerated with seminormal acetic acid and filtered through activated charcoal and P, K and Ca were determined quantitatively.

It has been found that inorganic calcium is more in the leaves (10-64 p.p.m. CaO with respect to the soil) (calculated on the basis of one lac plants to the acre) than in the stem (9-32 p.p.m. CaO with respect to the soil) at the pre-bud stage, but is less in the leaves (0.02-0.04 p.p.m. CaO with

respect to the soil) than in the stem (0.2-0.4 p.p.m.) at the bud stage; in the harvest stage also it is less in the leaves (1.8-6.4 p.p.m. CaO with respect to the soil) than in the stem (2.6-20.5 p.p.m. CaO). At pre-bud stage K_2O as well as P is more in the leaves than in the stem. At bud stage P is more in the leaves than in the stem but at the harvest stage it is the reverse. This shows that it may be that analyses of inorganic ions in the leaves at the earlier stages and of the stem at the harvest stage may be used to indicate the manurial status of a soil. Further work is in progress.

(*b*) *Accumulation of inorganic P, N and K in the tip leaf tissues*.—Tip leaves of two months old plants were cut into thin pieces with a sharp blade, macerated with seminormal acetic acid, filtered with activated charcoal and N, P and K were determined by qualitative colorimetric methods.

The preliminary findings are that in general there is an accumulation of inorganic P more in *olitorius* than those in *capsularis*. Accumulation of inorganic K is practically nil and of inorganic N has been found only in cases where nitrogen has been added in a very heavy dose.

(*c*) *Uptake of total nitrogen by the leaves and bark*.—A preliminary study was made with a purpose to know the amount of withdrawal of N by the plant grown under different conditions and manurial treatment.

It has been found that barks withdraw per plant from 0.17-0.29 gm of nitrogen in case of unmanured plots and in case of heavily manured plots the withdrawal is 0.46-0.81 gms in *olitorius*. In *capsularis* under normal conditions, this withdrawal amounts to 0.09 gms in unmanured and 0.49 gms in heavily manured plots, whilst in water logged conditions, these figures are 0.05 and 0.11 gms per plant respectively.

In case of normal *capsularis*, the withdrawal by leaves is of the order of 0.48 gms of nitrogen per plant and in case of water logged plants, the withdrawal has been found to be only 0.08 gms of nitrogen per plant. The withdrawal by the leaves of *olitorius* in unmanured plots comes to 0.76-1.28 gms per plant.

Taking an average of one lac plants to the acre, the withdrawal of N by the barks in case of *olitorius* unmanured plots comes to 37-63 lb. per acre and in *capsularis* 20 lb. under normal conditions. The withdrawal of N by the leaves in *olitorius* unmanured plots comes to 165-280 lb. of N per acre and in case of *capsularis* it is 105 lb. Usually about 80% of leaves fall down, and as such they are automatically returned to the soil. Taking the quantity of nitrogen returned to the soil into consideration, the ultimate exhaustion of the soil due to growing of jute would come to 70-100 lb. N per acre in case of *olitorius* and 40 lb. N in case of *capsularis*. This comes as 20-50 parts per million in terms of coil. By chemical methods it is very difficult to detect such small variations of total N and this is within the limits of experimental error. This leads to the same conclusion as already mentioned that it is not possible to detect the exhaustion in soil so far nitrogen is concerned by cropping with jute only for one year.

5. Attempts to find out Maximum possible yield of fibre under the influence of Nitrogen

Though the results show a promising trend particularly in *capsularis* yet no conclusion is to be drawn as regards yield per acre. As the plot sizes were very small, the experiment is being repeated this year.

VII. DISEASES

1. Study of the Effects of Environmental Factors on Secondary Infection due to Macrophomina Phaseoli

Data obtained from the 'Date of Sowing' experiments show similar trend of results as were observed in the year 1950-51. Critical period of leaf infection can be overcome by early sowing but seedling blight and collar-rot cannot be avoided by such measures. Reports received from different parts of West Bengal, where jute-potato rotation is practised show that early sowings do not escape seedling blight ; but such diseased plots after being ploughed down were often resown in the same season without having a second seedling blight.

The stem-rot per cent of the different treatments of the date of sowing experiment is given in Table XXV (A) and

XXV (B). Although the early sowings B and C were better than D from disease aspects, their total vegetative period was much shorter than D; consequently their yields were lower than that of D. In 1951, sowings from 16th March to 16th April had to be maintained by irrigation in their early stages. It appears that on high and mid lands sowing is best done with the early norwester showers.

TABLE XXV (A)

C. capsularis (D154)

Showing mean stem-rot percent at different dates, all figures are mean of 6 replications.

Treatments and dates of sowings	1-6-51	16-6-51	30-6-51	16-7-51	31-7-51	16-8-51	29-8-51	15-9-51	29-9-51	16-10-51	31-10-51
A. 16.3.51	1·23	2·59	1·70	2·58	1·83	3·62					
B. 1.4.51	1·45	2·60	1·68	0·53	0·51	3·88					
C. 16.4.51	1·12	1·94	1·38	1·36	1·62	3·48					
D. 1.5.51	1·11	0·90	1·00	1·19	2·40	4·09	6·29	5·57			
E. 16.5.51	3·02	2·42	0·74	3·19	3·25	3·90	5.48	3.84			
F. 1.6.51		3.47	5·03	8.67	5·40	6·42	6·87	4·59	3·73		
G. 16.6.51			0·26	20·11	13·95	16·72	12·22	10·05	8·98	9·95	
H. 1.7.51				1·83	4·47	4·91	4·47	8·47	5·30	7·61	7·64

TABLE XXV (B)

Showing mean stem-rot percent at different dates, all figures are mean of 6 replications,

C. olitorius (C. G)

Treatments with date of sowing	1-6-51	16-6-51	30-6-51	17-7-51	1-8-51	17-8.51	29-8-51	15 9-51	29-9-51	16-10 51	31-10-51
A. 16-3-52 ...	2·31	1·38	0·86	4·01	...	...	...	...	...	...	...
B. 1-4-51 ...	0·30	1·97	1·20	0·69	1·36	...	...	...	...	...	...
C. 16-4-51 ...	2·42	0·13	0·80	0·42	1·59	4·92	...	...	...	...	...
D. 1-5-51 ...	1·72	0·49	0·95	0·67	2-12	5 85	4·28	4·15	...	...	...
E. 16-5-51 ...	1·00	0·27	1·51	0·60	1·66	5·10	4·98	2·04	...	...	...
F. 1-6-51 ...	...	0·31	1·63	2·13	1·71	4·38	1·29	2·06	3·98	...	...
G. 16-6-51 ...	...	...	0·08	0·20	1·23	3·89	2·67	3·80	2·14	13·85	...
H. 1-7-51 ...	...	...	...	0·70	4·20	5·32	2·80	8·73	5·47	8·87	2·97

2. Study of the Stem-rot Fungus

(*i*) *Inoculation experiments with Macrophomina phaseoli.*—The long-term experiments designed for studying the probable factors limiting pathogenicity were abandoned as the Institute was scheduled to be shifted to its permanent site at Barrackpore.

(*ii*) *Study of the cultural characteristics.*—In the course of study of the cultures isolated from different parts of the jute growing areas, 2 very virulent strains were established. These 2 strains cause epidemic collar and root rot in medium and light soils of West Bengal, specially in plots where jute is followed by potato. There are some variations in the morphological characters of these strains from the one causing stem-rot at Chinsurah farm. A large number of stock cultures are being made, with a view to have a complete and comparative study of the relationships of geographically separated forms (?) of *Macrophomina phaseoli* (*Rhizoctonia bataticola* Taub).

3. Other Diseases

(*i*) *Chlorosis* : *Nature and manner of transmission.*—In 1950 it was found that progenies of a chlorotic plant almost always divided into two groups : (*i*) some showing chlorotic symptoms and (*ii*) others apparently healthy, *i.e.*, without any phenotypical exhibition of chlorotic symptoms. In 1950 two plants, one from each of the two groups, were selected in the different chlorotic type plots. The seeds from such plants were sown in different plots and the results are give in Table XXVI.

It will be seen from the table that chlorotic selections gave chlorotic progeny in 10 cases out of 13; and in 3 cases, contrary to expectations, no chlorotic plants were found. Out of 12 selections from apparently non-chlorotic plants, 6 were found to have no chlorotic progenies, whereas the rest of the 6 had very low percentage of chlorotic progenies.

The above facts show that either suppression of symptoms might have occurred in the parental selections or pollen from chlorotic parent might have introduced chlorosis in the unexpected cases. It should be also noted that *C. capsularis* is normally self-pollinated with about 4 per cent probability of intercross.

TABLE XXVI

Showing percentage of chlorotic plants observed in the selection tests.

Chlorotic parent of 1950	Culture Selection 1951	Type	Total plant	Percent chlorosis	
				1950	1952
G ...	8525	Chlorotic	477	1·3	1·26
I ...	8547	-do-	201	10·0	81·09
R ...	8553	-do-	367	17·0	21·25
E ...	8555	-do-	424	8·4	67·92
M ...	8557	-do-	299	12 0	72·24
L ...	8527	-do-	236	20·4	79·24
S ...	8551	-do-	226	7·9	3·54
N ...	8549	-do-	765	1·7	5·36
O ...	8559	-do-	257	2·5	1·21
P ...	8561	-do-	638	23·0	2·66
T ...	8536	-do-	804	6·5	0·00
F ...	8534	-do-	581	0·04	0·00
U ...	8529	-do-	1691	46·7	0·00
T ...	8533	Non-chlorotic	667	...	0·00
F ...	8535	-do-	901	...	0·00
N ...	8550	-do-	1403	...	0·00
R ...	8554	-do-	1452	...	0·00
E ...	8556	-do-	834	...	0·00
O ...	8560	-do-	688	...	0·00
G ...	8526	-do-	576	...	0·17
S ...	8552	-do-	676	...	1·04
M ...	8558	-do-	721	...	2·77
L ...	8528	-do-	1223	...	4·91
I ...	8548	-do-	600	...	1·33
P ...	8562	-do-	1619	...	0·41

(*ii*) *Incidence of soft-rot in different varieties.*—Incidence of soft-rot caused by *Sclerotium rolfsii* (Corticium vagum) in the *C. capsularis* Varietal Trial No. 1 and *C. olitorius* Varietal Trial No. 1, show no difference in degree of resistance. Moreover in the absence of controlled conditions, presence of other pathogens such as *Macrophomina phaseoli* and *Colletotrichum* sp. made it difficult to ascertain the role of *Sclerotium rolfsi* as primary pathogen, and as secondary pathogen. However, the incidence was confined to the later period (during July and August).

(*iii*) *Viability of sclerotia of Sclerotium rolfsi.*—Sclerotia collected from infected plants in 1949 and stored in air-tight glass bottles survived up till March 1951 but failed to germinate afterwards. Sclerotia produced artificially in August, 1949 failed to germinate in March 1952.

4. Control Measures

(*i*) *Selection of stem- and root-rot resistant types.*—33 selections from *C. capsularis* improved strains, 21 selections from *C. olitorius* improved strains and 48 selections from heterozygous *capsularis* materials were brought forward for further studies in 1952-53. There was no significant incidence of root-rot or stem-rot in the trials, although artificial inoculum was given in each trial. From observations recorded from the replicated *capsularis* varietal trials No. 1 and No. 2, it was found that Jap. Rd. and C42-Nj-412 were respectively highly susceptible to stem-rot and other varieties had no significant differences amongst them as shown in Table XXVII.

Amongst the improved *olitorius* strains there was no significant difference of resistance to stem-rot. From the observations recorded from the replicated *olitorius* varietal trial No. 1, no significant difference to resistance to stem-rot was noticed as shown in Table XXVIII.

TABLE XXVII

Showing incidence of stem-rot, in *C. Capsularis* strains

Verietal Trial No. I.		Varietal Trial No. II	
Variety	Mean stem-rot %	Variety	Mean stem-rot%
39-212	2·97	C42-Kj-322	5·2
Fanduk	3·44	Halmehera	4·3
C42-Kj-321	4·00	Kamardani	2·9
Orissa 6J	4·10	Assam 16	6·7
Deshimara	4·51	C42-Kj-320	5·1
D154	5·56	Hewti	6·2
C41-13	6·51	Fanduk	3·2
Jap Rd.	17 15	D386	4·1
		C42-Nj-412	28·0
		D154	3·1
S.E.%	5·5	S.E.%	32·9
C.D.	5·47	C.D.	8·7

TABLE XXVIII

Showing incidence of stem-rot in *C. olitorius* strains

Variety				*Mean stem-rot %*
O40-753	...	...	...	11.86
O39-620	...	...	...	12.04
O40-632	...	...	...	9.87
R26	...	...	...	13.51
C. G.	...	...	...	10.98
		P	...	Large
		S.E.%	...	6.5

(ii) Application of fertilisers to check incidence of disease.— Observations were kept in different manurial trials conducted in the Chinsurah farm by Agronomy and Chemistry sections in a trial conducted by the latter section the treatments included different sources of N at different levels and their combinations and P included in only two treatments. There was heavy leaf infection in a number of plots in the *capsularis* trial but it was independent of the action of fertilisers. The infection was due to water logging and consequent arrest of

growth. There was no significant difference among the treatments. In the *olitorius* trial having same treatments differences were observed in the degree of incidence of stem-rot but were not due to differences in the combination or rate of application and as such have no manurial signficance.

(*iii*) *Seed treatment and storage—Performance of old seeds.*—In 1951 seeds stored for different lengths of time, including treated and untreated ones, were sown in randomised replicated plots for comparative study of their yields. The different seeds used, their germination percentage prior to sowing and other particulars about storage are given in Table XXIX (A) and XXIX (B).

TABLE XXIX (A)

Comparative yield of crop raised from old and fresh seeds

***C. capsularis* (D154)**

Layout—Replicated randomised blocks in 6 replications.

Effective plot size—0·0025 acre

Sown on 28.5.51 and harvested on 18.9.51 at 50% flowering.

Collected in (Year)	Treatment Other particulars of storage	Germination % on 20.5.51	Seed wt. used per plot (gm)	Yield per acre (Md)	Percent on control
1948	Stored in air-tight bottles. Treated with Agrosan GN on 23.5.49.	72	30	23·25	103·67
1948	Stored in air-tight bottles. Untreated	55	30	21·82	97·33
1948	Stored in tins. Kept in damp godown	7	200	20·26	90·34
1949	Stored in galvanized-iron bins. Treated with Agrosan GN in December, 1949	68	30	21·04	93·81
1949	Stored in tins. Untreated ...	90	30	23·01	102·63
1949	Stored in air-tight bottles. Treated with excess of Agrosan G N	85	30	19·57	87·27
1949	Stored in air-tight bottles. Untreated	80	30	21·33	95·11
1950	Collected after rains ...	95	30	21·41	95·48
1950	Fresh normal seeds. Stored in seed bin	95	30	22·43	100·000
	P—Large S. E.%—6·6				

TABLE XXIX (B)

Comparative yield of crop raised from old and fresh seeds.

(*C. olitorius C. G.*)

Layout—Replicated randomised blocks in 6 replications.

Effective plot size—0·0025 acre

Sown on 30-5-51 and harvested on 14-9-51 at 50% flowering.

Collected in (Year)	Treatment Other particulars of storage	Germination %on 20-5-51	Seed wt used per plot (gm)	Yield per acre (Md)	Percent on control
1948	Stored in air-tight bottles. Treated with Agrosan GN on 12-7-49	81	10	19·26	91·89
1948	Stored in air-tight bottles. Treated with excess of Agrosan GN on 12-7-49 ...	46	18	20·28	96·77
1949	Stored in seed bin. Untreated...	98	10	24·79	118·26
1949	Stored in seed bin. Treated with Agrosan GN in December, 1949	57	14	19·67	93·84
1950	Collected after rains. Seeds were rainsoaked ; followed by drying in sun. Stored in seed bin ...	81	10	19·89	94·88
1950	Fresh normal seed. Stored in Seed bin	84	10	20·96	100·00
	P—Large S. E.%—6·36				

It would be seen from the tables that an adjustment had to be made in the seed rate in 1 case in *C. capsularis* and in 2 cases in *C. olitorius*, when the germination was poor. The differences in the yields were insignificant. The date of flowering was in the same sequence in all the treatments. The conclusions are that old viable seeds are capable of giving normal crop provided other factors governing the yield are normal.

Seed testing.—In order to establish a standard method of germination test certain investigations were carried out in detail. It was found that in a sample of freshly collected jute seeds there are some immature yet viable seeds which are usually lighter. Proper winnowing can eliminate such seeds. A fresh sample of seeds can, if properly stored, give cent per cent

germination at the time of next crop season. The majority of the viable seeds in any fresh sample germinate within 24 hours. In badly stored seeds, however, the viability is not of same potentiality, hence the process of germination takes place through a longer period. In a petridish test the percentage of germination is always higher than that observed in the field Of the total number of plants emerged from any given sample in the field, the majority however comes from seeds that would germinate in 24 hours in a petridish and those which germinate after 48 and 72 hours constitute a very small portion of the final stand. It has, however, been seen that there is no significant difference in height, base diameter and yield amongst the plants raised from seeds germinated after 24 hours or 48 hours or 72 hours.

From the study of a large number of known samples it appears that a sample of seed can be certified as fresh when 70% seeds germinate within 24 hours.

(*iv*) *Chemical sprays to control leaf infection.*—Regular trials were not possible to carry out in Chinsurah. Work on this, however, was conducted at Tarakeswar, reports on which are given separately.

VIII. PESTS

During the season, *Anomis sabulifera* spread out in an epidemic form and caused appreciable damage to the crop. Incidence of other pests except *Diacrisia obliqua* and *Nupserha bicolor* subsp. *postbrunnea* was comparatively negligible.

Effect of pest damage on fibre yield :—Trials on the effect of pest damage on fibre yield were conducted one at the Institute's farm and the other in cultivators' plots at Tarakeswar.

The trial conducted at the Farm had to be abandoned as the crop was not at all uniform. The trial conducted in the cultivators' field has been successful and the result has been given under the "Pest and Disease Control Scheme," Tarakeswar.

Effect of different dates of sowing on the incidences of major pests of Jute.—Two trials on the "Effect of different

dates of sowing on the incidences of *Laphygma exigua, Apion corchori, Anomis sabulifera* and *Hemitarsonemus latus*, one with *capsularis* (D154) and the other with *olitorius* (C.G.) jute were conducted in two replicated randomised layouts as in the previous year.

Sowings were done at about 15 days' interval starting from the 16th March. There were altogether eight sowings and the last sowing was done on the 1st July. Periodical observations were taken from all the treatments on the extent of attack by *L. exigua, A. corchori, A. sabulifera* and *H. latus* from trials with *capsularis* (D154) and *olitorius* (C.G.) crops. Data on the extent of attack by *H. latus* have been discarded as at one stage the affected plants were weeded out through oversight by some inexperienced labour from some of the treatments.

Result on the incidence of *L. exigua* (Table XXX) corroborated previous two years' data and support the observation that the liability of the crop towards damage by *L. exigua* increases when the crop is sown early upto the middle of April.

TABLE—XXX.

Effect of different dates of sowing on the extent of attack by *Laphygma exigua* in %.

Capsularis (D154)

Treatments (Dates of sowing)		30 days old	60 days old	90 days old	120 days old
A	16-3-51	15·89	5·82	0·00	0·00
B	1-4 51	26·13	0·00	0·00	0·00
C	16-4-51	12·09	0·00	0·00	0·00
D	1-5-51	3·06	0·00	0·00	0·00
E	16-5-51	0·00	0·00	0·00	0·00
F	1-6-51	0·00	0·00	0·00	0·00
G	16-6-51	0·12	0·00	0·00	0·00
H	1-7-51	0·89	0 00	0·00	0·00
C. D.		12·37	...	...	...

Olitorius (C. G.)

Treatments (Dates of sowing)		30 days old	60 days old	90 days old	120 days old
A	19-3-51	19·81	0·95	0·00	0·00
B	1-4-51	17·91	0·00	0·00	0·00
C	16-4-51	1·71	0·00	0·00	0·13
D	1-5-51	0·15	0·00	0·00	0·00
E	16-5-52	0·15	0·00	0·00	0·00
F	1-6-51	0·00	0·00	0·00	0·00
G	16-6-51	0·30	0·00	0·00	0·00
H	1-7-51	0·00	0·00	0·00	0·00
C. D.		9·03	...	...	...

Incidence of *A. corchori* for this season also showed the same trend as in the previous years'. Early sown crop is likely to become more susceptible to *Apion* damages than the late sown ones as is evident from Table XXXI.

TABLE XXXI

Effect of different dates of sowing on the extent of attack by *Apion corchori* in %.

Capsularis (D154)

Treatments (Dates of sowing)		1-30 days	31-60 days	61-90 days	91-120 days
A	16-3-51	2·64	14·82	24·22	33·50
B	1-4-51	0·43	9·30	30·30	41·12
C	16-4 51	2·40	14·99	17·98	4·42
D	1-5-51	3·58	32·60	16·76	2·83
E	16-5-51	10·28	25·39	5·04	8·36
F	1-6-51	8·53	5·48	10·93	18·03
G	16-6-51	9·01	12·16	7·35	4·31
H	1-7-51	4·32	2·02	13·36	1·37
C.D.	...	4·09	10·60	12·36	12·59

Olitorius (C.G.)

Treatments (Dates of sowing)		1-30 days	31-60 days	91-60 days	91-120 days
A	16-3-51	1·31	2·91	4·26	15·07
B	1-4-51	0·05	2·32	14·37	46·70
C	16-4-51	0·27	5·66	23·77	10·65
D	1-5-51	0·11	15·33	36 50	2·85
E	16-5-51	1·84	16·36	15·98	8·88
F	1-6-51	1·32	16·83	13·12	8·09
G	16-6-51	7·45	10·20	7·04	6·77
H	1-7-51	2·89	8·22	2·49	2·93
C.D.	...	3·06	5·68	10·49	11·62

Liability towards damage by *Anomis sabulifera* has been found to increase for crops sown late. Observation made during the season corroborated previous two years' result and are given in Table XXXII.

TABLE XXXII.

Effect of different dates of sowing on the extent of attack by *A. sabulifera* in %

Capularis (D154)

Treatments (Dates of sowing)		30 days old	60 days old	90 days old	120 days old
A	16-3-51 ...	0·00	4·61	0·34	27·79
B	1-4-51 ...	2·34	3·26	17·66	37·66
C	16-4-51 ...	6·08	0·20	59·56	21·86
D	1-5-51 ...	1·27	50·00	85·99	10·56
E	16-5-51 ...	0·24	63·89	45·80	0 00
F	1-6-51 ...	20·56	100·00	9·25	0·00
G	16-6-51 ...	25·90	61·46	0·00	0·00
H	1-7-51 ...	11·93	19·34	0·00	0·00
C. D.	...	8·44	15·92	16·18	6·92

Olitorius (C. G.)

	Treatments (Dates of sowing)		30 days old	60 days old	90 days old	120 days old
A	16-3-51	...	0·00	1·27	0·32	14·62
B	1 4-51	...	0·61	0·00	13·73	40·57
C	16-4-51	...	0·71	0·15	23·07	35·93
D	1-5-51	...	0·00	15·30	89·06	16·05
E	16 5-51	...	0·55	22 59	50·13	0.00
F	1-6-51	...	2·75	93·50	7·44	0·00
G	16-6-51	...	27·89	63·99	0·00	0·00
H	1-7-51	...	23·36	11·96	0·00	0·00
	C. D.	...	18·14	16·44	10·49	11·77

Selection for resistance against Apion corchori.—Further selections were made from the previous year's cultures. These fresh selections were again put under trial for study of comparative resistance. Some of the *capsularis* cultures are showing promising result. These would be put in trial against D154 as control to assess their superiority, if any, over the standard type D154.

No significant differences have been obtained amongst the *olitorius* cultures with regard to resistance against *A. corchori.*

Nupserha bicolor subsp. postbrunnea.—Further studies on *N. bicolor* subsp. *postbrunnea* was continued. It has been ascertained that the females during oviposition determines the zone of susceptibility on the host stem.

This years observations also corroborated last year's finding that in 99.6% cases, susceptibility of the host is restricted to the stem diameter range of 0.2 cm. to 0.4 cm. while

in 0.4% cases damage is done in stem with diameter between 0.41 - 0.5 cm.

Loss of plant height is evidently regulated by the actual seat of oviposition on the stem within the susceptible diameter range. Frequencies of occurrences of height classes lost with susceptible stem diameter classes at the lowest level of damage show that the highest frequency lies with height ranging between 10 cm. to 20 cm. from the top and the stem diameter between 0.26 cm. to 0.3 cm. (Table XXXIII).

With susceptibility restricted to the apical part of the stem, the loss of fibre becomes insignificant with damage done to older crops. It has been estimated that the loss of stem extends generally from 30.02% — 6.32% on average from young to old crop. 101 — 200 cm. height group appears to suffer more than other height classes. (Table XXXIV).

TABLE XXXIII.

Diameter classes in cms.	Height classes in cms.				
	0-5	5·1-10	10·1-15	15·1-20	20·1-25
A 0-0·19 ...	...	...	...	...	...
B 0·2-0·25 ...	2	30	82	80	37
C 0·26-0·3 ...	1	36	206	203	113
D 0·31-0·35 ...	1	5	49	67	38
E 0·36-0·4 ...	...	3	17	35	18
F 0·41-0·45 ...	...	...	...	...	...
Total ...	4	74	354	385	206

(continued on next page)

Diameter classes in cms.	Height classes in cms.					
	25·1-30	30·1-35	35·1-40	40·1-45	45·1-50	Total
A 0-0·19	...	...	...	...	...	...
B 0·2-0·25	5	1	1	...	1	239
C 0·26-0·3	32	11	...	2	...	604
D 0·31-0·35	11	3	1	1	...	176
E 0·36-0·4	4	1	...	...	...	78
F 0·41-0·45	...	...	...	...	...	...
TOTAL ...	52	16	2	3	1	1097

TABLE XXXIV.

Loss of plant height on average in different height classes of attacked plants.

Height classes in cm.	Frequency	Average height of class in cm.	Average height lost in cm.
1-50 ...	15	41·67	12·51
51-100 ...	114	82·34	16·58
101-150 ...	525	127·97	16·13
151-200 ...	440	171·34	16·60
201-250 ...	122	219·81	17·11
251-300 ...	10	259·63	14·43

Jute Pest Forecast for 1951-52 season :

This is for the first time an experimental jute pest forecast was made on the basis of certain very encouraging results

obtained during the last few years. The forecast was given publicity through the press. It was published in different local dailies such as "The Statesman", "The Amrita Bazar Patrika", "The Hindusthan Standard" etc., on 15/16th May, 1951.

The work on "Jute Pest Forecast" is still in its experimental stage as the results obtained from trials here is under large scale test in different jute tracts specially in West Bengal. The work covers only the major pests of jute. The pests concerned are *Laphygma exigua*, *Apion corchori*, *Anomis sabulifera* and *Hemitarsonemus latus*.

The 'Jute Pest Forecast' made for the 1951-52 may briefly be stated as follows :—

"(1) Incidence of *Laphygma exigua* is expected to be very little.

(2) *Hemitarsonemus latus* which was very widely spread in an epidemic form during 1949-50 is likely to cause very minor damages only.

(3) Incidence of *Apion corchori* is expected to be a little less than usual.

(4) *Anomis sabulifera* is likely to cause maximum damages to the jute crop during the season and its incidence may spread in an epidemic form.

Incidence of this pest is likely to start from the last week of June. Second fortnight of July and first fortnight of August are expected to be the peak damage periods".

Side by side with the issue of the forecast arrangements were made in co-operation of the State Agricultural Department for receiving pest incidence reports from the Field Assistant of the Jute Development Scheme stationed in different jute growing areas. This was considered necessary to verify the correctness of the forecast. Informations received from the Field Assistants, Agricultural Officers and cultivators in West Bengal have finally confirmed the forecast made. It was found that the incidence of *Anomis sabulifera* was very widespread in almost all the district of West Bengal.

IX. THE PEST & DISEASE CONTROL SCHEME, TARAKESWAR

An area of 302 bighas (about 101 acres) of cultivators' land was brought under the scope of study of control measures.

The soil in the area is light, sandy to sandy loam. The usual practice is to apply 10 maunds of mustard cake before potato along with inadequate quantity of F.Y.M. and compost. In some cases ammonium sulphate is also used. Nothing is applied before jute except pond sludge by certain cultivators. Only *C. olitorius* is cultivated in this area. Although the Jute Agricultural Research Institute-improved *olitorius* strains were much appreciated but sufficient quantity of seeds could not be supplied. Sowing took place between 2nd and 15th May after 1.5 and 0.8 inches rain respectively. Germination was gappy and seedlings suffered from drought. In many plots re-sowing took place on 27th and 28th May following two inches of rain on 26th May. Such resown plots did well both from disease and yield point of view. All Jute Agricultural Research Institute improved strains when sown late proved better than early sown crop.

Diseases.—Most of the plots having jute-potato combination suffered from seedling blight, stem-rot, root-rot, collar-rot due to *Macrophomina phaseoli*. When the disease is limited to 10% the cultivators ignore it; but when death due to root-rot assumes larger proportion they abandon jute cultivation in preference to paddy or keep the land fallow. Loss of crop due to root-rot and stem-rot was enormous in farmer's plots. Recommended control measures were adopted for checking the incidence of disease by treating the seeds, by the application of lime and of muriate of potash in the soil and by spraying. As the disease is mainly soil borne, spraying was ineffective in these areas. The results of the protection measures are given below :

A total of six maunds of jute seeds was treated with organomercuric compound (Agrosan GN). It was found that seed treatment gave protection from seedling blight to a great extent but was of no use against collar-rot and root-rot appearing from July to September. Regarding resistance to root-rot

O40-632, an improved strain of Jute Agricultural Research Institute proved better than all other strains. Complete resistance is absent in any of the known strains.

Slaked lime was applied at various rates from 3 to 6 maunds per bigha in a large number of plots, notorious for root-rot of jute and rotting of potato. It was found that application of lime increased the yield of jute over that obtained in 1950 from the same area. In case of potato the yield was lower in comparison to the yield obtained in 1950 although lime application helped in checking tuber-rot in many cases. Action of lime in checking root-rot is not fully established but results are encouraging. Lime application has also been found to check white ants in fields.

Application of muriate of potash alone did not give good results when applied. In combination with ammonium sulphate the yield was high and the incidence of disease was less.

On the basis of the results obtained in previous years cultivation of *aus* paddy for two consecutive years has been recommended in areas which are notorious for root-rot of jute. But the cultivators are reluctant to stop jute cultivation even for a year because they get more profit out of jute.

PESTS—Anomis sabulifera spread out in an epidemic form during the season and caused maximum amount of damage to the crop. Incidence of other pests were much less in comparison. Out of 76.55% area under pest incidence *A. sabulifera* alone was responsible for causing damage to 67.37% area.

There was a general demand for pest control from the cultivators who also co-operated for combating the spread of pests.

Effect of pest damage on yield.—To determine the effect of pest damages on yield, one trial was conducted in the cultivators' plots covering an area of 2 acres. Each plot was of 1/3 acre approximately. There were two treatments—"All-pests controlled" and "No-pest controlled"—with 3 replications,

Plots were, however, not in one compact block. For recording the final yield, 5% area of each treatment was harvested, steeped, fibre extracted, dried and weighed under the supervision of our staff of the station. It has been found that the average yield per acre in all-pests controlled treatments has been 18.98 maunds as against 16.30 maunds in no-pests controlled treatments. Pests are thus responsible for a decrease of 2.68 maunds per acre or the loss in terms of per cent has been to the extent of 14.12.

As the season recorded maximum damage by *A. sabulifera*, the decrease in yield represents to a great extent the amount of damage by the said pest.

X. SUBSTITUTE FIBRES

1. Botanical and Agronomical Studies

(1) *Collection of seeds and other propagative materials.*—In all 100 samples of seed and other propagative materials of different fibre crops obtained from Indian and foreign sources were grown for observation :—1. *Hibiscus cannabinus* (*a*) Indian—18 samples. (*b*) foreign—13 samples. 2. *Hibiscus sabdariffa* (*a*) Indian—10 samples. 3. *Hibiscus esculentus*—Indian—2 samples. 4. *Hibiscus abelmoschus*—Indian—1 sample. 5. *Crotalaria juncea*—(*a*) Indian—8 samples. (*b*) foreign—1 sample. 6. *Abutilon* spp.—(*a*) Indian—1 sample. (*b*) foreign—6 samples. 7. *Linum usitatisimum*—Indian—20 samples. 8. *Cannabis sativa*—(*a*) Indian—1 sample. (*b*) foreign—1 sample. 9. *Agave* spp.—Indian—5 samples, and one each (Indian) of the following miscellaneous fibre plants : *Sida rhombifolia, Urena lobata, Urena sinuata, Abroma augusta, Malachra capitata, Sesbania aculeata, Boehmeria nivea, Pentapetes phoenicea, Hibiscus sp., Triumfetta sp., Thespesia lampus, Urera baccifera* and *Helicteres isora.*

Of the 18 Indian samples received as *H. cannabinus*, five showed all the characteristics of *H. sabdariffa;* of the remaining 13 true *H. cannabinus* samples as many as 10 proved to be very susceptible to a suspected virus disease. Of the 13 foreign samples of *H. cannabinus*, only 6 (one Chinese, one Russian and 4 American) have proved to be free from disease. Of the

miscellaneous fibre samples seeds of *Thespesia lampus*, *Helicteres isora*, *Triumfetta sp.* and *Urera baccifera* completely failed to germinate both in the laboratory and in the field.

18 samples (*H. cannabinus*—6, *H. sabdariffa*—9, *Helicteres isora*—1, *Crotalaria retusa*—1 and *H. vitifolius*—1) received very late in the season were preserved for sowing during the next season.

2. *Study of the agrobotanical characteristics of different fibre plants.*—Distinguishing features in growth and development of all the fibre plants under observation were recorded. Some outstanding features observed are (*a*) Presence of hard bristles on the plants of *H. cannabinus* raised from the seeds of 3 American and 1 Chinese sample as against the complete absence of bristles in other collections, (*b*) comparatively bigger flowers and capsules in the American sample of *kenaf* (commercial strain), (*c*) presence of a type with absolutely simple and entire leaves in an isolated type from the American sample of *kenaf* (commercial strain).

The fibre percentage in respect of green weight has been ascertained with regard to some fibre plants under observation and is shown below:—

Fibre crops	percentage of fibre in respect of green weight.
1. *Hibiscus cannabinus*	4.09%
2. *Hibiscus sabdariffa var altissima* ...	4.91%
3. *Hibiscus sabdariffa* (green pigmented) ...	5.49%
4. *Hibiscus esculentus*	2.34%
5. *Hibiscus sp.*	3.42%
6. *Crotalaria juncea*	2.75%
7. *Malachra capitata*	2.92%
8. *Abutilon sp.*	1.90%
9. *Sesbania aculeata*	1.50%
10. *Urena lobata*	3.68%
11. *Urena sinuata*	5.40%
12. *Sida rhombifolia*	2.72%
13. *Pentapetes phoenicea*	2.14%
14. *Cannabis sativa*	2.33%

The fall in percentage of fibre in some of the fibre plants, under observations as compared to that of last year is due partly to a general unsatisfactory growth of the plants.

3. *Isolation and Selection of Types* :—141 selections of *H. cannabinus* were grown for observation and further selection. The germination of all the selections was quite satisfactory. At the seedling stage, however, there was a severe attack of a beetle which damaged quite a good number of these cultures completely. These lost selections were, however, recovered mostly from a progeny trial population. Quite a good number of them was rejected on further scrutiny. Out of the old selections, 97 were carried forward for further study.

124 fresh selections based on yield, maturity, pigment pattern on plant parts, leaf shape, plant height, base diameter and disease resistance were made in *H. cannabinus*.

In *H. sabdariffa* 91 selections of last year were grown and studied. From the 16 non-bristled cultures, 23 secondary selections have been made for further study. The bristled cultures have all been rejected. 20 fresh selections, based on plant height, base diameter, absence of bristles on plant parts and early maturity, were made. From the *Abutilon sp.* and *Hibiscus esculentus* 16 and 6 fresh selections respectively were done on the basis of maximum plant height and base diameter.

4. *Hybridization.*—The F1 progeny of a number of crosses which were made last year amongst the six different pigmentation grades of *H. cannabinus* were grown. But the cultures were all destroyed by a beetle at the seedling stage. So a fresh attempt was made in this direction and more than hundred intraspecific crosses were made between the different pigmented grades of Mesta and seeds of the successful crosses have been collected for future study.

Besides these, 8 successful fresh crosses were obtained between *H. cannabinus* and an unidentified sp. of Hibiscus possessing different morphological characteristics.

In *Hibiscus sabdariffa* 73 successful fresh intraspecific crosses of 19 different combinations were made, based on pigmentation

pattern and leaf characters. 58 back crosses between the F1 and their respective parents were made to study the genic constitution of the parents. Besides these 34 F2 families of crosses with different combinations were studied and the segregation of phenotypes was statistically worked out. Monogenic differences have been found in 5 of these combinations whereas in the sixth a digenic ratio has been obtained; 24 back-cross families of the above six combinations have also been studied and the expected ratio with the recessive parents (1:1) has been obtained in all of them.

A large number of interspecific crosses between *H. cannabinus* (2n=36) and *H. sabdariffa* (2n=72) were attempted without success. With a view to overcome this cross incompatibility an attempt was made to try the method of vegetative rapproachement between the two species. For this purpose twenty two successful graftings between *H. cannabinus* and *H. sabdariffa* stems with either as scion or stock were reciprocally obtained. The seeds of these grafts will be sown next year to study the morphological characteristics and behaviour of the progeny and also for making second generation of grafts and interspecific crosses.

5. *Date of Sowing Experiments.* This experiment was continued with *H. cannabinus* and *H. sabdariffa* var *altissima* sown in alternate lines in small plots at intervals of 15 days. Morphological differences of plants and incidence of flowering due to seasonal variations throughout the year were recorded. In *H. cannabinus* the sowing of 3rd week of March has given the maximum height of the plant whereas in *H. sabdariffa* var *altissima the* February sowing has given the maximum height.

In the case of *H. cannabinus* the two early sowings of December (1950) completed their life cycle by the month of March (1951). The plants sown between the months of January and middle of June irrespective of date, flowered in the month of September and in *H. sabdariffa* plants of all sowings between the month of December (1950) and September (1951) flowered in the month of November (1951).

From the preliminary observations it appears that in case of *H. sabdariffa* the flowering tends to be timely fixed although

some slight variations may occur due to fluctuation of temperature. But in case of *H. cannabinus* no definite conclusion can be drawn at this stage until the observations are carried for two or three years more.

2. *Agronomic and Breeding Trials*:—

(*i*) *Trial of spacing cum harvest stages with H. cannabinus.*—This test was repeated during the year on the same split plot factorial model and with the same number of main treatments and subtreatments as in the previous year. The crop was severely damaged by a malignant virus disease yielding practically no result for statistical examination.

(*ii*) *Progeny trial.*—A trial of 36 promising primary selections of *H. cannabinus* conducted to study their respective yield performance and for further selection, unfortunately failed due to the severe attack of a beetle at the seedling stage. The seeds of only one selection were not recovered and preserved for future studies.

(*iii*) *Trial of spacing cum harvest stages with H. sabdariffa var altissima.*—This experiment is also a repetition of the same experiment conducted last year according to the same design. The spacing treatments in the trial were light thinning × 12″, 2 inches × 12″, 4″ × 12″ and 6″ × 12″. There were also 3 stages of harvest—bud stage, flower stage and pod stage. Not much yield differences have been observed among the various treatments.

From a study of mortality of plants in the experimental units under the 5 main treatments it has been observed that in the 6″ × 12″ plots the mortality is at the minimum and as the spacing between plants in lines is reduced the mortality increases progressively the highest being in the plots under treatment light thinning × 12″ and broadcast. A thorough investigation of this aspect of the problem will be undertaken next year.

(*iv*) A varietal trial of 4 varieties of *H. sabdariffa* obtained from different sources was conducted according to a latin square design. The results are given in the following Table XXXV.

TABLE—XXXV.

Varietal trial of H. sabdariffa.
Layout—Latin square (4 x 4)
Date of sowing—25.5.51
Effective plot size—·014 acre.

Treatments (varieties)	Adjusted yield per acre (Mds.)	Percent on control	Date of harvest
Green pigmented type	20·91	113·03	24·11·51
Altissima (green) (control)	18·50	100·00	22·11·51
Goldcoast	13·29	71·84	7·12·51
Tagtail	12·13	65·57	5·11·51

P	...	·01	...
C. D.	...	1·64 mds. per acre.	
S. E. %	...	1·79	

It may be seen that the differences in yield between the varieties under observation are highly significant. One of our new selections (Green pigmented) has given the highest yield being over 13% higher than the control (*altissima green*). The Tagtail variety (Hyderabad) has given the poorest yield which may be due to its dwarf and bushy habit and early maturity. Between Tagtail and Goldcoast varieties there is no significant difference. Regarding the duration of life at harvest, Goldcoast variety has the longest and Tagtail variety the shortest.

(*v*) A seed-rate experiment with *H. sabdariffa* (Green pigmented) was done to determine the optimum seed rate with seven different seed rates per acre starting from 10 lbs per acre to 40 lbs per acre (10-15-20-25-30-35-40 lbs) in randomised blocks with 5 replications. Except cleaning them of weeds at the early stages of growth no other field operation such as thinning of plants was done in the experimental plots.

The results of this test are given in the following table :

TABLE XXXVI

Treatments. (Seed rate per acre)	Stand		% of mortality	Average height (ft.)	Green wt. per acre (Md)	Per plant Green wt. (gm)	Fibre yield per acre (Md)
	Theoretical (At 90% germination)	Actual (At harvest					
10 lbs	204300	195919	4·10	10·27	513·19	113·50	22·19
15 ,,	306450	218764	28·61	10·41	546·89	95·34	25·46
20 ,,	408600	267287	34·58	9·68	544·27	77·18	23·28
25 ,,	510750	309809	39·34	9·62	556·48	68·10	24·35
30 ,,	612900	372282	39·26	9·42	552·78	63·56	22·95
35 ,,	715050	349529	51·12	9·48	549·45	61·74	22·83
40 ,,	817200	421962	48·37	8·35	537·66	54·48	21·36
P ...	0·01			0·01	Large	0·01	Large
S.E.% ...	2·36			1·66	4·48	4·77	3·78
C.D.	*28584 42			0·64	...	15·44	...

It may be seen from the table that there have been no significant differences in the green weight of plants per acre and the fibre yield per acre.

Significant differences are found in the green weight per plant, average height and the stand of the crop at harvest and the following are noted :

(*a*) The progressive increase in mortality of plants with the increase in seed rate.

(*b*) The progressive decrease in the average growth of the plant (height) with the increasing seed rates.

(*c*) The progressive fall in green weight per plant with the increasing seed rates.

(*vi*) An yield trial with different fibre crops in the same test, was done to compare the respective yield and quality of fibre, in a randomised block layout with 4 replications. Two types

of each of Sunnhemp, Mesta, Roselle and Jute making eight treatments in all were included in the test. The results are given in the following Table XXXVII.

TABLE XXXVII.

Yield trial with different fibre crops.

Layout—Replicated randomised block with 4 replications.
Date of sowing—10-6-51.
Effective plot size—·003 acre.

Treatments (Fibre crops)	Adjusted yield per acre (Mds.)	Percentage of fibre wt. in respect of Green wt.	Date of harvest
Sunnhemp (Bullandshar)	10·93	2·75	18-9-51
„ (Hyderabad)	7·20	3·70	27-9-51
Mesta (National Nursery)	8·07	3·36	2-10-51
„ (Grade 5) ...	10·83	4·09	18-9-51
Roselle (Green) ...	16·31	4·91	22-11-51
„ (G. P.) ...	20·87	5·49	22-11-51
Jute (C. G.) ...	16·42	5·14	13-9-51
„ (D154) ...	13·44	4·72	14-9-51

P ... ·01
C.D. ... 5·92 mds. per acre.
S.E.% ... 1·42

It may be seen from the Table XXXVII that the test is significant at 1% level of probability. Our new selection of *Hibiscus sabdariffa* (green pigmented) has given the highest yield of fibre but is significantly at par with jute (C.G.) and *H. sabdariffa* var *altissima*.

3. *Special Fibres* :—

1. *Sunnhemp*—(*a*) Study of the growth characteristics of the collections—9 samples of Sunnhemp (old 4, new 4 and

foreign 1) were grown in Kharif season both at Chinsurah and Barrackpore Farm. At Chinsurah the growth of the crop was very satisfactory and unlike last year the crop was practically free from *Fusarium*.

At Barrackpore Farm on the other hand all these 4 old samples were severely attacked with *Fusarium* and destroyed. The four new indigenous collections sown rather late in the season escaped this disease. The Kharif crop at Chinsurah Farm did not produce much seed. At Barrackpore Farm from the crop that escaped the *Fusarium* attack a fairly good quantity of seed was obtained. A second lot of sowing of all the sunnhemp types except the foreign one was done in winter to supplement the seed requirement for future observations.

(*b*) A varietal trial of 4 sunnhemp types was carried out at Chinsurah Farm according to a latin square design to assess their fibre yield and quality. The results are given in the following Table XXXVIII.

TABLE—XXXVIII.

Sunnhemp varietal trial.

Layout—Latin Square (4 x 4)

Date of sowing—9.6.51.

Effective plot size—·014 acre.

Treatment (varieties)		Yield per acre (Mds.)	Date of harvest
Bullandshar	...	9·73	22·9·51
Hyderabad Bold size	...	9·58	29·9·51
Hyderabad small size	...	8·80	24·10·51
Gwalior	...	8·70	18·9·51
P	...	Large	
S. E. %	...	2·8	

The differences in yield of fibre observed between the varieties are not significant. The fibre samples of all treatments of the various trials have been sent to T.R.L. for quality test and the results are awaited.

The results of quality test of fibre of different treatment of Line vs Broadcast experiment with *H. cannabinus* and *H. sabdariffa* var *altissima* conducted in 1950-51 which have been received this season are given below :

TABLE XII

Line vs Broadcast experiments with. *H. cannabinus* and *H. sabdariffa* var *altissima*

Treatments	Quality ratio	
	H. cannabinus	*H. sabdariffa*
Bud stage Broadcast ...	80±0·8	71±1·3
„ „ No thinning × 12″ ...	86±1·1	69·±09
„ „ 2″ × 12″ ...	97±1·0	66±1·7
„ „ 4″ × 12″ ...	84±1·1	73±1·0
„ „ 6″ × 12″ ...	112±2·4	65±1·0
Flower stage Broadcast ...	89±1·6	80±1·6
„ „ No thinning × 12″	93±1·4	80±2·0
„ „ 2″ × 12″ ...	97±1·0	73±1·9
„ „ 4″ × 12″ ...	71±0·8	75±0·7
„ „ 6″ × 12″ ...	101±1·4	71±1·6
Pod stage Broadcast ...	115±1·3	73±15
„ „ No thinning × 12″ ...	96±1·4	75±1·3
„ „ 2″ × 12″ ...	75±1·7	69±0·9
„ „ 4″ × 12″ ...	88±1·4	71±0·9
„ „ 6″12″ ...	65±1·2	71±1·0

(*ii*) *Linseed.*— (*a*) Agro-botanical studies—The twenty flax linseed hybrid strains of last year were carried forward and sown during the year for study of their respective agro-botani-

cal characteristics and multiplication of seeds. Observations on the following characteristics of all the strains were recorded —Plant height at harvest, number of branches per plant, weight of plant at harvest, seed weight per plant, straw weight per plant, colour of petal, colour of filament, colour of anther, colour of ovary, colour of style and stigma, size of capsules, number of seeds per grm., colour of seed, date of 1st appearance of flower bud, date of 1st flowering, date of 50% flowering, date of maturity at harvest, yield of straw in mds. per acre.

(*b*) A varietal trial with 13 of the dual purpose linseed strains of Indian Agricultural Research Institute, New Delhi and 4 other evolved at Kanpur and Sabour was conducted at Nilganj farm in replicated randomised blocks with 4 replications. Since seeds of none of the strains under observations, were enough for a trial in big-sized plots, the test had to be conducted in small plots (10′ × 5′) in which the sowing was done in 5 lines 10′ ft. long.

The Indian Agricultural Research Institute strain (flax J.W.S. Linseed N.C. 4) under the conditions of experiment at Barrackpore has given significantly higher yield of straw than all the strains with the exception of three other I.A.R.I. strains namely, flax tall × N.P. 377, flax tall × linseed N.C. 7 and flax tall × linseed N.C. 9 and with which statistically it is at par. The poorest yield has been given by the rust resistant strain R.R349.

For want of fibre extracting machine it has not been possible to extract the fibres for a comparative study.

(*iii*) *Ramie*— The old plantation at Chinsurah farm was maintained and a good quantity of seed has been raised. From this small samples have been supplied to a few intending growers. In the next season attempts will be made to set up a fresh Ramie plantation at Nilganj Farm. By crude method of hand extraction some fibre was extracted from the Ramie canes.

Investigations into the possibility of evolving a suitable chemical process of degumming of Ramie fibre were undertaken. Three experiments were carried out with different doses of alkali, oxalates and acids. It was found that a treatment with

6% sulphuric acid for 24 hours followed by bleaching gave the best result. Further experiments would be carried out this year.

(*iv*) *Agave*—The nursery of Agave bulbils at Chinsurah Farm has been maintained. 12 bulbils each of different species of Agave (*i*) local, (*ii*)*sisalana*, (*iii*) *cantala* and 2 bulbils of *Furcrerea* received from Warangal (Hyderabad) during the season were planted in the nursery at the Chinsurah Farm. Next season all the seedlings will be transferred to Nilganj Farm where they will be planted in a permanent site for future observation.

II. Anatomical and Cytological Studies :—

The study of the distinguishing features of the fibre bundles and characteristics of the ultimate fibre cells in different fibre plants under observation has been in progress.

III. Physiological Studies

1. Physiology of growth in mesta and roselle with reference to the formation of bark and fibre growth and wood during the life cycle of the plant.

Preliminary investigations were done on Mesta (*H. cannabinus*) and Roselle (*H. sabdariffa* var. *altissima*). The plants were grown in replicated plots and 3 plants from each replication were taken each time. Samples were taken at different stages of growth, *viz.*, 52, 83, 112 and 158 days growth from the sowing date. These stages corresponded with the vegetative, flowering and fruit forming stages of the plant. The stem of the plants was divided into small segments of 6″ each from the bottom towards the apex and they were investigated for (*a*) fresh weight, (*b*) dry weight, (*c*) stripped weight of the crude bark, (*d*) weight of the wood, (*e*) the fibre content was also examined after chemical determination by chemical retting.

The following category of results were obtained :—(1) The relation of moisture content per unit of dry matter produced. (2) The rate of total growth in terms of dry matter. (3) The

comparative rate of formation of wood in relation to the growth of the bark. (4) The ratio of growth of bark to that of wood at different periods of growth and at different lengths of the stem. (5) The comparative rate of pure fibre production in relation to crude bark formation.

(*a*) *Variations in growth of crude bark and wood.*—The results indicated the same trend of variations in the formation of crude bark and wood as was recorded in different varieties of jute. The formation of crude bark was found to be more in the basal regions of the stem in the early vegetative stage in both Mesta and Roselle but Mesta recorded a greater quantity of bark formation than in Roselle, in the early stages but with increased growth in length of the stem and at later stages of flower and fruiting, Roselle recorded higher quantity of bark formation than Mesta in all the zones of the stem. There was a progressive growth of bark in the different zones with the progress of the growing season.

The ratio of bark formation to that of wood formation showed a progressive decrease from vegetative to the flowering and fruiting stage showing a corresponding increase in wood formation in later stages of growth. The ratio was maintained within 50 to 50 of bark and wood.

(*b*) *Percentage distribution of bark on the stem.*—The results showed more distribution of fibre in the bottom regions than in middle and top. This distribution changed from vegetative to the reproductive phase, showing a shifting of fibre percentage towards the upper regions of the stem. In general the physiology of growth of bark and wood in Mesta and Roselle showed the same variation as the bark fibre growth in case of different varieties of jute as recorded elsewhere.

2. *Nutritional investigations on Mesta and Roselle.*

In order to study the effect of different sources of nitrogen at a level of 20 lbs available nitrogen per acre, an experiment was conducted with Mesta and Roselle in randomised blocks with

4 replications. The trial in Mesta failed due to heavy virus infection. The results of the trial on Roselle are given below :

TABLE XL

Layout—Randomised block with 4 replications.
Effective plot size—·002 acre.
Sown on 25-5-51 and harvested on 27-11-51.

Treatment	Yield per acre in maunds.	% over control
$(NH_4)_2SO_4$ ...	27·22	105·1
KNO_3 ...	24·23	93·5
$NaNO_3$ ...	20·75	80·1
F. Y. M. ...	29·39	113·5
Compost ...	26·39	101·0
Control (No manure) ...	25·90	100·0

P	...	·01
C. D.	...	5·68 mds/acre
S. E. %	...	3·55

From the table above it may be observed that F.Y.M. has given significantly the higher yield of fibre than the treatment $NaNO_3$. But the treatments F.Y.M., $(NH_4)_2SO_4$, compost KNO_3 and control are statistically at par as regards yield of fibre.

IV. Diseases

Hibiscus cannabinus : (*i*) *Virus*—For the second year epidemic of virus broke out in one of the trials where the source of seed was southern districts of Uttar Pradesh. The main symptoms included loss of lustre, paling of the green colour, crinkling of the lamina, rolling of lobes towards the main veins, twisting and abnormal elongation of petiole, arrest of apical growth, all resulting in a bunchy top. Gradually leaves with-

ered away in extreme cases; flowering and pod production were rare. Seeds were collected from one diseased plant which was specially cared for to produce seed. Out of 105 seeds planted this year (1952 season) only 96 germinated.

The mode of transmission of mesta virus could not be determined. For want of proper facilities (i.e. Green house and Insectarium) the role of certain insects found associated in mesta crop as vectors could not be assessed.

(*ii*) *Brown-rot*—Mesta was also found to suffer from a fungal disease which is provisionally termed 'Brown-rot'. Except the American commercial strain all the types and varieties both indigenous and foreign were found to be susceptible to this disease. The attack is restricted in apical region amongst the young tissues mainly. Young stipules, leaf buds, leaves, soft growing stems are the parts where symptoms of attack are first manifested. The tip or margin of the stipule and leaf buds and leaves turn brown and gradually wither away. Very often a sooty black mark is found at the base of the leaf or on the internode, which gradually extends, turns brown and a scar is developed. In some cases such as in 'Tagtail' variety the entire stem-tip is lost. Larger leaves, if attacked, exhibits a symmetry and intensification of pigmentation. On a microscopic study sporodochia were found, spores borne singly on conidiophore in a mass in each sporodochium; sporeshyaline, thin walled ellipsoid with rounded apices, single celled, 11.7-15.0 μ × 3.38-4.9 μ, mostly 13 μ × 3.5 μ ; mycelium scanty both in nature and in culture.

The fungus has been sent for identification to the Institute of Mycology, Kew, England.

(*iii*) *Cercospora hibisci*.—Towards the end of September, 1951 when the flowering started there was a heavy attack of *cercospora* in all the mesta crop of the farm. The attack of *cercospora* was indicated by presence of sooty powdery mass of spores on leaf lamina which rolled and dropped off. The calyx was also severely attacked and as a result no seed was produced and many selections were lost.

Spray of Perenox or Bordeaux did not give satisfactory results.

2. *Aloe* :—Leaves of Aloe (*Agave cantala*) were found to be attacked with *Colletotrihum* sp. Attack started at the apex and the rotting travelled downwards.

3. *Crotolaria juncea—Sunn hemp*—(*i*) *Wilt*—Severe *Fusarium* wilt occurred in early sown plots. In late sown plots the attack was less severe. In many cases complete failure of crop was observed. None of the type collections could be classed as resistant to wilt. A few selections, however, were made.

Seed treatment with organo-mercuric compounds (Landisan and Agrosan GN) could not give any appreciable protection from wilt which started from the end of June and was at the peak in the middle of August.

(*ii*) *Rust*—In the year under report no rust attack was recorded.

V. Pests

Incidences of Jassids were rather very widespread amongst the important substitute fibre crops. The pest was put under check by application of suitable insecticides.

Podagrica apicefulva caused considerable damage to mesta and *altissima* crops. The stem including the growing apical region and the leaves were damaged severely by the pests. Adults, in general, feed upon the epidermal and softer cortical tissues of the stem leaving the harder fibre strands. But damage, when done to the succulent apical region of the stem, the growth is arrested resulting in death in some cases.

It was, however, found that the spiny type of *altissima* offer greater resistance to *P. apicefulva* than the spineless type.

P. apicefulva was also found prevalent in mesta crop suffering from some malformations, *viz.*, stuntedness with closely apposed leaves at the top. To determine whether *P. apicefulva* plays any role in causing such malformations, small trials under controlled conditions were undertaken. Results were inconclusive and nothing definite can be said yet.

It may, however, be stated that in our own selection of *H. cannabinus* induced damage by *P. apicefulva*, did not develop any malformations, although they were damaged to some extent.

MISCELLANEOUS

Enquiries.—A large number of reports and comments on enquiries of various nature relating to jute and substitute fibres were written and submitted during the year under report.

Changes in the staff.—Dr. K. V. Srinath, Cytogeneticist left the Institute on 1.4.52 and joined the Institute of Food Technology at Mysore. The following appointments were made during the period :—

Sri P. K. Das, Farm Manager on 14.11.51.

Sri S. K. Majumder, Physiological Asstt. on 10.3.52.

Sri A. K. Dutta, Anatomical Assistant on 13.3.52.

Sri A. K. Kundu, Microbiological Asstt. on 21.3.52.

The post of the Assistant Botanist remained vacant throughout the year under report.

Visitors.—Among the visitors to the Institute during the year under report, the names of the following may be mentioned :

Sri Thirumal Rao, Deputy Minister, Food & Agriculture, Government of India.

Sardar Datar Singh, President, Indian Central Jute Committee.

Mr. I. G. Kennedy, Vice-President, Indian Central Jute Committee.

Sri K. D. Jalan, Member, Indian Central Jute Committee.

Sri K. M. Das, Member, Indian Central Jute Committee.

Sri Sital Chandra Ghosh, Member, Indian Central Jute Committee.

Dr. H. K. Nandi, Director of Agriculture, West Bengal.

Mr. John A. Manawwar, Additional Director of Agriculture, U.P.

Mr. S. A. Majid, Director of Agriculture, Assam.

Dr. P. N. Bhaduri, Indian Agricultural Research Institute.

PUBLICATIONS

The following is a list of papers published or sent for publication during the year :—

1. Dutt, N. (1952)—*Pinnaspis* sp—a new coccid pest on *Corchorus capsularis* Linn. Current Science, Vol. 21. No. 3.

2. Dutt, N. (1952)—*Nupserha bicolor* Thoms. subsp. *post-brunnea* Bruen—a new pest on *C. olitorius* Linn. Nature, Vol. 170, No. 4320.

3. Dutt, R. M. (1952)—Meiosis in *Corchorus capsularis* Linn. Science & Culture, Vol. 17, No. 12.

4. Dutt, R. M. (1952)—Meiosis in *C. olitorius* Linn. Science & Culture (Press).

5. Dutt, R. M. (1952)—Chromosome numbers of some types of *C. capsularis* Linn. Science & Culture (In Press).

6. Ghosh, T. and Basak, M. (1951)—Chlorosis in Jute. Science & Culture. Vol. 17.

7. Kar, B. K. and De Sarkar, B. K. (1952)—Physiology of fibre growth in Jute (*Corchorus*). Proceedings of the 39th Indian Science Congress.

8. Kundu, B. C. (1951)—Origin of Jute. Indian Journal of Genetics and Plant Breeding. Vol. 11, No. 1.

9. Kundu, B. C. (1952)—Jute, more Jute. Jute and Gunny Review. 3rd Annual Number.

10. Mukherjee, M. K. and Halder, G. (1952)—A short note on the effect of Selenates in the transformation of soil phosphates. Proceedings of Indian Society of Soil Science, 1952.

11. Mukherjee, M. K. and Halder, G. (1952)—A note on the fixation of phosphates under Chinsurah field conditions with jute. Proceedings of Indian Society of Soil Science, 1952.

12 Mukherjee, M. K. and Halder, G. (1952)—A short note on the transformation of soil phosphates under the influence of different fertilisers and manures with jute crop. Proceedings of Indian Society of Soil Science, 1952.

13. Sanyal, A. T. (1952)—Possibilities of growing jute as line-crop and development of suitable jute seed drill. Jute Bulletin, Vol. 15. No. 1.

14. Srinath, K. V. and Kundu, B. C. (1952)—Cytological studies of pollen tube growth in reciprocal crosses between *Corchorus capsularis* Linn. and *Corchorus olitorius* Linn. Cytologia (In Press).

B. C. KUNDU,
Director, J.A.R.I.

STAFF

A list of the staff is given below :—

1.	Director	...	Dr. B. C. Kundu, M.A., Ph.D., F.L.S., F.N.I.

Agronomical Section

2.	Agronomist	...	Sri A. T. Sanyal, B.Sc. (Ag.), Assoc. I.A.R.I.
3.	Assistant	...	Sri B. K. Das, B.Sc. (Ag.)
4.	-do-	...	Sri D. B. Dua, B.Sc. (Ag.)

Botanical Section

5.	Botanist	...	Sri B. Das Gupta, M.Sc.
6.	Asstt. Botanist	...	Vacant
7.	Assistant	...	Sri M. S. Sharma, M.Sc.,
8.	-do-	...	Sri K. L. Ghosh, B.Sc., B.Ag.

Anatomical Section

9.	Anatomical Assistant	...	Sri N. S. Rao, M.Sc., Ag.
10.	-do-	...	Sri A. K. Dutta, M.Sc.
11.	Jr. Anatomical Asstt.		Sri S. B. Saha, B.Sc.

Physiological Section

12.	Physiologist	...	Dr. B. K. Kar, M.Sc., Ph.D. (Leipzig.)
13.	Assistant	...	Sri S. K. Mazumdar, M.Sc.
14.	Jr. Assistant	...	Sri B. K. De Sarkar, B.Sc.

Cytogenetical Section

15.	Cytogeneticist	...	Dr K. V. Srinath, M.Sc., Ph.D., (since resigned).
16.	Assistant	...	Sri R. M. Datta, M.Sc.

Mycological Section

17.	Assistant Mycologist	...	Sri T. Ghosh, M.Sc.
18.	Assistant	...	Sri K. V. George, M.Sc., (Ag).
19.	Jr. Asstt.		Sri M. Basak, B.Sc.

Entomological Section

20.	Assistant Entomologist		Sri N. Dutt, M.Sc.
21.	Assistant	...	Sri S. D. Mitra, M.Sc.
22.	Jr. Assistant	...	Sri N. Sen Gupta, B.Sc.

Chemical Section

23.	Asstt. Chemist	...	Dr. M. K. Mukherjee, M.Sc., Ph.D.
24.	Microbiological Asstt.		Sri A. K. Kundu, M.Sc.
25.	Chemical Assistant	...	Vacant.
26.	Jr. Assistant	...	Sri G. Halder, B.Sc.

Statistical Section

27.	Statistician	...	Vacant.
28.	Assistant	...	Vacant.

Substitute Fibre Section

29.	Asstt. Botanist	...	Sri K. P. Roy, L. Ag., Assoc., I.A.R.I.
30.	Assistant	...	Sri P. Sanyal, M.Sc., Assoc., I.A.R.I.
31.	-do-	...	Sri A. N. Dutta, B. Ag.

Library

32.	Librarian	...	Sri A. K. Sur, M.Sc., Dip. Lib.

Farm

33.	Farm Manager	...	Sri P. K. Das, B.Sc., Ag.
34.	Head Clerk	...	Sri R. Chakraborty, B.A.

APPENDIX

Programme and Progress of Work

JUTE

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
I. BREEDING AND GENETICS OF JUTE.		
(*i*) Collection of varieties and types including wild species of *Corchorus*.	Plants raised from 367 indigenous and 10 foreign samples of jute seeds received from China, Brazil, Japan, Florida & Philippines were studied and 671 primary selections carried forward. The foreign materials yielded some new forms not met with in Indian types.	Collection of varieties & types, both indigenous and exotic, to be continued.
	14 samples of seeds of different wild species of *Corchorus* received from various sources were grown and studied.	Collection of wild species of *Corchorus* to be continued.
(*ii*) Breeding of improved strains of jute.	6 *capsularis* and one *olitorius* breeding trials were sown with 294 cultures brought forward from previous year. 5406 secondary selections were made for further studies. None of the cultures proved significantly superior to the controls but 13 cultures yield-	To be continued.

	ing as good and having desirable characters like earliness, non-branching habit, etc. were carried forward.	
	Varietal trials—3 varietal trials, 2 *capsularis* and 1 *olitorius* were carried out with some of the strains evolved by this Institute. 2 *capsularis* strains, viz., C39-212 and C41-13 yielding 24% and 12% respectively higher than the control (D154) proved significantly superior. C39-212 gave a quality ratio of 104 as compared to 91 of D154.	To be repeated.
	The 3 *olitorius* improved strains, O40-753,-O40-632 and O39-620 yielded 39, 37 and 27% higher and proved significantly superior to the control (C.G.). O39-620 maintained its better quality of fibre with a quality ratio of 89 as against 80 of C.G.	
Polyploidy & interspecific hybridization in jute.	20 *capsularis* plants (C_4 generation) obtained from the 1948 colchicine treated series maintained the polyploid features. Fertility of the plants was low, 3 of the plants producing less than 5 pods each; bulk seeds could be obtained only from 17 progenies.	Interspecific crosses will be attempted between polyploids of the two species.
	Of the 1950 treatment only 3 capsules from 3 different *capsularis* plants belonging to	

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
	0.0125% conc. of colchicine and 6,12 and 18 hours durations of treatment gave polyploid progenies. 4 *olitorius* plants (1950 treated series) gave polyploid progenies and were confirmed as 4n=28.	
Vegetative rapprochement as a means of overcoming interspecific cross-incompatibility.	Of the 20 interspecific grafts made last year 6, which yielded seed, were sown. 8 successful second generation grafts were obtained.	Interspecific grafting to be continued for some more generations before crosses between the two species are attempted.
(*iii*) Inheritance of characters. Genetic strains—	51 pure strains along with 12 new cultures brought forward from the purification series were grown and studied.	True breeding strains will be maintained and isolation of new strains will be continued.
Isolation of full-green genotypes.	Of the 10 possible full-green genotypes, 6 have been isolated so far. Test crosses for isolation of the remaining genotypes were made.	To be continued.
Anthocyanin pigmentation.	The mode of inheritance of the dark-red pigmentation pattern in *capsularis* was studied. It was found to be the highest member of the red group having the constitution $CC^{A^D} A^D rr$ In course of the study a	Studies completed.

	new synthetic pigmentation pattern which may be designated as green-dark-red having the constitution CCA^{D}A^{D}RR—the highest member of the green-pigmented group was produced.	
	F_1s of Indian and foreign types were studied. Fresh crosses and back-crosses were made for inheritance of pigmentation.	Study of F_1, F_2 and back-cross families. Back-cross to be made. Fresh crosses covering the missing combinations to be made.
	At least 5 F_1 selections per type of cross, the back-crosses, fresh crosses and parents were carried forward.	
Extra-axillary branching.	The axillary branching habit of Indian types was found to be dominant over the extra-axillary branching habit of the foreign types and controlled by a single factor pair.	Studies completed.
Repand (wavy) leaf in *capsularis*.	The repand leaf character was found to be dominant over the normal leaf and controlled by a single factor pair.	Studies completed.
Leaf variant.	The F_2 progenies segregated into normal and variant types. Further studies are in progress.	To be continued.
Seed-coat colour in *olitorius*.	To study the inheritance of seed-coat colour in *olitorius* types, 43 successful crosses were obtained.	To be continued.

Programme of work as sanctioned.	Progress of work in 1951-1952	Future programme of work in 1952-53.
Chlorosis.	The progenies of chlorotic selections were studies and classified. The chlorotic parents of the crosses were found to be heterozygous. The F_1s were rejected.	To be continued.
Subvention trials.	Among the *capsularis* improved strains, C39-212 proved to be the best in a combined analysis of the data from trials of all the States during 1951-52. Of the *olitorius* strains O40-753 and O40-632 proved significantly superior to Locals.	To be continued.
II. ANATOMICAL STUDIES. (*i*) Developmental anatomy of axillary buds.	*Corchorus siliquosus*, a natural polyploid is taken up for study. The development of axillary buds is the same as in D154. Further work is in progress.	To be continued.
(*ii*) Structure and quality of fibre in jute. (*iii*) Study of secondary xylem vessels in relation to yield of fibre.	The number of ultimate fibres per fibre bundle is more in plants harvested two months after sowing than in later stages. This decrease is likely to be due to splitting of fibre strands by secondary rays. ¶ Xylem vessels are wider in plants two months old than at later stages. The later decrease in width may be due to addition of more of	To be continued.

	xylem and pressure towards the centre. Relationship could not be established between maximum vessel diameter and yield of fibre.	
(*iv*) Study of formation of fibre layers in relation to plant height and base diameter.	The number of fibre layers are related more to the base diameter than to the plant height.	To be continued.
(*v*) Routine identification of fibre samples.	Fibre samples from various sources were examined and necessary informations supplied.	To be continued.
III. CYTOGENETICAL INVESTIGATIONS.		
(*i*) Study of factors involved in stray incompatibility between *C. capsularis* and *C. olitorius* in crosses.	The pollen grains germinate on the stigma of other species and grow along its style and that there is no perceptible difference between the rate of growth and other features between the compatible pollen tubes. It is concluded that the incompatibility does not operate in the stigma and the style.	Behaviour of the pollen tubes of these two species inside the ovaries, when crossed, to be studied.
	The pollen grains and the rate of growth of pollen tubes have been studied.	To be continued.
(*ii*) Study of chromosomes.	(*i*) Chromosome survey of indigenous and exotic species is in progress. Chromosome numbers in *C. fascicularis* and *C. trilocularis*	To be continued.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
	are determined to be 7. Hypo- and Hyperploidy are observed in *C. capsularis*, *C. olitorius*, *C. trilocularis*, *C. fasciculatis* and *C. tridens* for the first time.	
(*iii*) Cytology of colchicine treated plants.	In spite of multivalent formation in mother cells fertility is high. Crosses were made with diploids to raise a triploid line.	Cytological investigations of these crossed materials.
	Induction of mutants by the use of irradiated pollen grains of *C. olitorius* and *C. capsularis* was done. The irradiated pollens were used both for self- and cross-pollinations. Seeds obtained are being sown.	To be continued along with cytological examination of the materials.
IV. PHYSIOLOGICAL STUDIES. (*i*) Investigation on the physiology of jute seeds.		
(*a*) Rate & frequency of flower opening and the nature of the flowering period.	The initiation of the first flower differed in different varieties of *capsularis*—78th day from date of sowing in Fanduk and 104th day in D154 while in *olitorius*, both C.G. and R26 flowering starts on the 78th day.	To be continued in other varieties.

(*b*) No. of seeds formed in capsules developed at different times of flowering period.	The average number of seeds formed in each capsule varied in accordance to the time of flower opening and consequent fruit setting. In D154 the number of seeds varied from 30.6 to 36.1, in Fanduk from 32.4 to 38.1 the maximum number being attained in 2nd, 3rd weeks. In Chinsurah Green the number of seeds varied from 123-167 and in R26 from 112-197 the maximum number being attained in 4th and 5th weeks of flowering.	To be continued in greater detail.
(*c*) The viability efficiency of the seeds formed in capsules developing at different times of flowering period.	Higher percentage of germination was noted in the seeds collected from capsules developing in the earlier weeks of flowering period in D154 and Fanduk and in the middle weeks of the flowering period in C.G. and R26.	To be continued.
(*d*) Effect of pre-sowing cold treatment (vernalization).	Crop raised from soaked seeds of D154 and C.G. treated with cold temperature (10°C) for a period of 26 days showed only some minor morphological variations.	To be continued.
(*ii*) Salt resistance experiments with jute seedlings.	Preliminary results showed that seedlings of both *capsularis* and *olitorius* resisted 1.5% of NaCl in the soil, but showed stunted growth and loss of chlorophyll. Very few flowers and pods were formed.	To be continued under farm conditions. Further work would be carried in some saline area of West Bengal.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
(*iii*) Root system in different jute species.	Growth and distribution of roots at various stages was further continued. One month old D154 showed the length of tap-root 2.5-4.0″ with small secondary roots. In C.G. the length of the tap-root was 4.0″-6.5″. At the bud stage the tap-root elongated to 10.0″-12.4″ in D154 and 19.4″-20.6″ in *olitorius*.	To be continued under different soil conditions and at different stages of growth.
(*iv*) Physiology of growth in different species & varieties of jute with reference to moisture content, bark formation and wood development during the life-cycle of the plant.	In the report of 1950-51 the results on D154 and C.G. were reported. The work has been further continued on *capsularis*-C41-13; Fanduk; C39-212; C42-Kj-320 and *olitorius*-R26; O40-632; O39-620 and O40-753.	
(*a*) Variations in dry weight	The results showed the same sequence of changes as was found in D154 and C.G. with varietal difference. More dry matter was formed in the basal regions of the *capsularis* stem than in *olitorius*, but in *olitorius* the dry matter was more evenly distributed along the whole length of the stem, resulting in the	To be continued. Branching and non-branching types would be included.

	formation of more dry matter in the *olitorius* varieties than in *capsularis* varieties for the same length of stem.	
(*b*) Variations in moisture content.	The maximum moisture content was obtained in the apical regions, which was associated with vegetative growth of young cells. The water economy changes from vegetative phase to the reproductive phase and then to the ripening phase.	To be continued.
(*c*) Percentage formation and distribution of bark in the stem.	The maximum percentage of distribution of fibre was found in the bottom regions than the middle and the top in all the stages. The varietal differences were noted. In the varieties of *capsularis* a higher percentage of bark distribution was found in the bottom regions in the early vegetative stage than in *olitorius* varieties. But in the middle and top regions of *olitorius* varieties recorded more bark percentage than in *capsularis* varieties.	To be continued in other varieties. Branching and non-branching types will also be included.
(*d*) Variations in the wood formation.	The values of wood content showed that for the same length of stem more wood was formed in the later stages in *olitorius* than in *capsularis* varieties.	To be continued.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
(*e*) Ratio of bark formation to that of wood formation.	In early and vegetative phase more bark was laid but in later stages of reproductive and fruiting stage more wood was laid (as observed in the case of D154 and C.G.)	To be continued.
(*f*) Variations of pure fibre content at different stages of growth in jute by chemical determination.	In D154 about 44% of fibre was formed during vegetative growth and in the flowering stage the percentage increased to 53-59% C.G. in early vegetative stage recorded 48% of fibre and during the flowering period the percentage varied from 55% to 65%. In terms of total dry matter the percentage varied from 21 to 23% in C.G. and 24 to 26% in D154.	To be continued in other varieties, as well as in Mesta and Roselle.
V. JUTE AGRONOMY.		
(*i*) Possibilities of growing jute in lines.	Fibre yield between the treatments were not significant, though line plots gave higher yields than the broadcast plot. In both the trials *capsularis* as well as *olitorius*, the cost of production in line plot was reduced by 20 to 25% than broadcast plots and the profit values in line plots were higher.	To be continued. Sowings to be done with hand pushed seed drill developed by Indian Central Jute Committee. Treatment of $4'' \times 12''$ to be dropped and replaced by hand weeding and thinning in line plots as done in broadcast.

	Line sowings on large scales were done in some cultivators' plots, the results of which were satisfactory.	To be continued.
	Modifications have been suggested in the bullock seed drill developed by U.P. Agricultural Department after proper trials.	Other spacing treatments to include various populations under manured and unmanured conditions. This work was not possible in 1951-52 for want of land.
	A hand pushed seed drill has been developed in collaboration with a local firm.	
(*ii*) Manurial trials—		
(*a*) Effects of N, P, K on *capsularis* and *olitorius* jute.	Responses recorded were only from N. Yield increases due to use of N were much higher in *capsularis* than in *olitorius*.	To be continued.
(*b*) Effect of organic and inorganic nitrogen on jute.	Inorganic nitrogen gave better responses, more so, in *capsularis*. Though the results were insignificant, in *olitorius* organic nitrogen contributed more towards yield than in *capsularis*.	To be continued.
(*c*) Time of application of ammonium sulphate in jute.	The treatment differences due to various times of application of ammonium sulphate were not significant, during the year under report.	To be continued.
(*d*) Comparative merit of inorganic nitrogen.	In *capsularis* ammonium sulphate gave the best response. In *olitorius*, however, the difference between ammonium sulphate,	To be continued. Other sources of nitrogen (inorganic) could not be included as they were not available. These will be included.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
	ammonium nitrate and potassium nitrate were insignificant. With both *capsularis* and *olitorius* jute sodium nitrate gave the lowest yield.	
(*iii*) Double cropping (low land).		
(*a*) Double cropping jute with paddy in low land area.	Later stages of harvest of jute gave higher yields of fibre. The yield of paddy was more from the jute plots harvested earlier. The yield of paddy as the second crop did not seem to suffer much due to growing of jute (as first crop) as compared to paddy alone, provided paddy was transplanted earlier or by the 3rd week of July.	To be continued.
(*b*) Double cropping with jute and paddy (in large scale) in the low land.	The profit obtained from double cropping the land with jute followed by paddy was much more than from single cropping the land with paddy alone.	To be continued.
(*iv*) Tripple cropping—		
(*a*) Triple cropping mid lands with *capsularis* jute, aman paddy and pulses.	Higher yields of fibre were obtained from later stages of jute harvest. The late variety of jute (D154) for the same period of growth, irrespective of the stages of maturity gave higher fibre yield than the early Fanduk. The highest profit was ob-	To be continued at Barrackpore (light soil) and Chinsurah (heavy soil).

	tained from late variety of jute, harvested late and followed by early paddy.	
(*b*) Triple cropping high-mid-lands with *olitorius* jute, aman paddy and pulses.	Jute yields increased with later stages of harvest. Manured plots gave slightly higher fibre yields than unmanured plots, but the difference was not significant. Profits were mainly from jute.	To be continued at Barrackpore and at Chinsurah.
(*v*) Manurial trials (in cultivators' plots) in jute growing States.	Simple manurial trials—78 in non-acid soils and 20 in acid soils were conducted in the various jute growing States. In acid soils of Bihar lime alone or in combination with nitrogen seemed to have increased the fibre yield appreciably. In non-acid soils of all the jute growing States (except Assam where no trial could be conducted) the application of nitrogen was found to be beneficial.	To be continued.
(*vi*) Date of sowing—with (*a*) *Capsularis jute.*	Sowings between 16th March and 1st May were found to be satisfactory. The best result was obtained from sowing of 1st May which is significantly superior to all other sowings of *capsularis* jute.	
(*b*) *Olitorius jute.*	The normal sowing period for *olitorius* jute was found to be between 15th April and 16th May. Sowings earlier to 15th April or later than 16th May gave significantly poorer yields of fibre.	To be continued in *capsularis* and *olitorius* varieties: (*a*) Doses of nitrogen varying from 10 to 120 lb N per acre and effects on jute.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
		(*b*) Economics of seed cum fibre from same crop and effect on quantity on fibre. (*c*) Effect of topping on jute. (*d*) Intercultural effects on jute. (*e*) Study of fibre at various portions of the plant at different stages of crop growth. (*f*) Trials of recommended practices in cultivators' plots.
V. Soil & Microbiological Studies. (*i*) Biochemical studies of retting jute, retting water & soil.		
(A) Action of different activators on retting of jute.	In the laboratory it has been found Bone dust or ammonium sulphate reduces retting period; when used in combination the reduction is more. Nitrates in many cases have reduced the retting period. The efficacy of ammonium oxalate under normal condition is due to the ammonium ion.	(*i*) Studies to find out the exact proportions of N, P & K under optimum conditions will be continued. (*ii*) Work to find out the chemical changes due to retting and methods to lower the period of retting will be undertaken.

(B) Isolation & characterisation of specific bacteria and fungi responsible for retting.	A few bacteria and 3 fungi were separated.	(*i*) To be continued.
(C) Microbial survey of retting waters.	Preliminary work has been done.	To be continued.
(D) Studies in the changes of soil micro-organisms.	Preliminary work has been done.	The work will be continued in detail.
(*ii*) Analysis of soils & manures for their chemical & mechanical constituents.		
(*a*) Routine analysis.	Routine analyses of several samples were done.	To be continued.
(*b*) Soil survey.	Preliminary work has been undertaken.	
(*iii*) Soil exhaustion studies.		
(*a*) To investigate the amount of soil in double and triple cropping lands.	Determinations of total N, exchangeable Ca, & K, available P and organic matter by wet combustion method have been made, for samples before jute, during jute after jute, after paddy and after pulse. It was found that under Chinsurah conditions, the soil, if exhausted at all, is exhausted to a very little degree by cropping with jute.	To be continued in greater detail.

Programme of work as sanctioned.	Progress of Work in 1951-52	Future programme of work in 1952-53.
(*b*) To study the amount of exhaustion in manurial trials with jute.	Findings are similar to that of double, triple cropping experiments.	To be continued in greater detail.
(*c*) Withdrawal by the plant of N, P, K.	Preliminary progress was made and inorganic ion concentration as well as total N, were determined.	To be continued. (*d*) Work on exhaution by different varieties.
(*iv*) Development of methods for determination of nutrients for advisory work in connection with manuring etc. (*v*) Role of plant nutrients and soil conditions regarding susceptibility to disease.	Some progress was made but for shortage of staff, this could not be pursued further.	To be continued.
(*vi*) Attempts will be made to find out maximum production capacity of jute, under the influence of nitrogen.	Preliminary work has been done.	To be continued in greater detail. (*vii*) Work on soil texture under the influence of krilium, silicates, organic matter & tamarind seed powder has been undertaken.

VII. DISEASES.

1. Study of the effect of environmental factors on secondary leaf infection due to *Macrophomina phaseoli*.	Besides the confirmation of earlier observations, it was found that sowings of 15th March were inferior to later sowings. Sowings of 1st May were found to be best both from yield & disease point of view.	To be continued in greater detail.
2. Study of the stem-rot fungus.		
(*i*) Inoculation experiments.		To be continued.
(*ii*) Study of the cultural characteristics.	3 strains of *Macrophomina phaseoli* (*Rhizoctonia*) were established, which differ from each other in many cultural characteristics.	Pathogenicity of the 3 isolated strains wll be tried against tandard varieties of jute.
3. Study of the biology of pathogens other than *Macrophomina phaseoli*.	(*i*) Chlorosis—An all-chlorotic strain has been selected. Crosses indicate that pollen transmission of chlorosis is possible.	Further crosses will be made to find out whether transmission is due to cytoplasmic aphimixis or not.
	(*ii*) Incidence of soft-rot as recorded in trials did not show any varietal resistance.	Studies on soft-rot will be continued.
	(*iii*) Viability of sclerotia from nature when stored failed to germinate after 26 months.	

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
4. Investigation on the methods of control of diseases.		
(*i*) Selection & breeding of resistant types.	(*i*) 102 selections were brought forward for further studies.	(*i*) To be continued.
(*ii*) Application of fertilisers to check incidence of disease.	(*ii*) Records kept from trials conducted by the Agronomy and Chemistry sections did not show any differences.	(*ii*) Records will be kept in yield trials to be conducted by Agronomy & Chemistry sections.
(*iii*) Seed treatment and storage.	(*iii*) It was found that crop obtained from old seeds was as good as that raised from fresh seeds. A standard method for germination tests was worked out.	(*iii*) Root-rod and seedling blight are found to be serious menace in fields where potato follows jute.
(*iv*) Chemical spray to control infection.	(*iv*) No regular trial was conducted at Chinsurah. But large scale operations were conducted at Tarakeswar.	Further work on control to be continued.
VIII. PESTS: Study on *Apion corchori*.	Study on anatomical variations of susceptible region of different types is in progress.	To be continued.

	No significant difference has been obtained among *olitorius* selections against *Apion corchori*, while some of the *capsularis* selections are showing promise.	To be continued.
	Like the previous years it has been found that *Apion corchori* causes more damage to crop raised early.	To be continued.
Study on *Laphygma exigua*.	Liability of crop towards *Laphygma* damage increases when the sowing is done by the middle of April.	To be continued.
Study on *Anomis sabulifera*.	Crop sown beyond middle of May became more liable to *Anomis sabulifera* damage.	To be continued.
Study on *Nupserha bicolor* subsp. *post-brunnea*.	Loss of stem due to the attack by this pest varies from 12.51 cm to 17.11 cm on average in different height groups, while 101 cm to 200 cm height group seems to suffer most by this pest.	Effect of different percentage of damage on yield.
Effect of pest damage on yield.	It has been found from trial conducted at Tarakeswar that pests were responsible for a decrease of 2.68 maunds of fibre per acre.	To be continued.
Substitute fibres.	Spiny type of *altissima* has been found to be more resistant than spineless type.	Investigations on pets of substitute fibre crop will be continued.
Studies on *Podagrica apicefulva*.	*Hibiscus cannabinus* has also been found to suffer heavily from *P. apicefulva*.	

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
I. Botanical & Agronomical Studies.	SUBSTITUTE FIBRES	
1. Collection of varieties and types.	In all 100 samples of different fibre crops (Indian and foreign) were grown for observation.	To be continued.
2. Study of the characteristics of different fibre plants.	The distinguising features in the growth and developmental characteristics of the different fibre plants under observation were recorded. Some of the outstanding features observed are—(*a*) presence of hard bristles on the plant parts of these American and one Chinese collection of Mesta as against the complete absence of bristles in other collections, (*b*) Comparatively bigger flowers and capsules in the American 'Kenaf' (Commercial strain).	To be continued.
3. Isolation and selection of types.	In *H. cannabinus* 141 old selections and in *H. sabdariffa* 91 of them were grown for observation and further selection. Fresh selections based on yield, maturity and other plant characters were made.	To be continued.

4. Hybridization.	92 fresh crosses both in *H. cannabinus* and *H. sabdariffa* and 50 back crosses in *H. sabdariffa* were made. 8 successful fresh crosses were obtained between *H. cannabinus* and an unidentified species of *Hibiscus* possessing peculiarly different morphological characteristics. Crosses between *H. sabdariffa* and *H. cannabinus* failed. With a view to overcome their cross incompatibility attempts were made to overcome the cross-incompatibility by vegetative rapprochement methods.	To be continued.
5. Date of sowing experiment.	This experiment was continued with sowings of *H. sabdariffa* var *altissima* and *H. cannabinus* at intervals of 15 days and crop performances studied.	To be continued.
6. Agronomic and breeding trials.		
(*i*) Trials of spacing cum stages of harvest with *H. cannabius.*	The crop failed due to attack of a malignant virus disease.	To be continued.
(*ii*) A trial of 36 primary selections of *H. cannabinus.*	The crop failed due to attack of a malignant virus disease.	To be continued. (*ii*) A seed rate experiment on *H. cannabinus* with different heed rates will be conducted to determine the optimum seed rate.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
(*iii*) Spacing cum stages of harvest with *H. sabdariffa* var. *altissima*.	There has not been much difference in yield of fibre among the various treatments.	To be continued.
(*iv*) Varietal trial of *Hibiscus sabdariffa*.	One of our new selections (Green pigmented type) has given the highest yield being over 13% higher than the control (Green *altissima*).	To be continued.
(*v*) Seed rate experiment with *H. sabdariffa*.	Seven different seed rates starting from 10 lb to 40 lb per acre (10, 15, 20, 25, 30, 35, 40) were tried. The differences in yield of fibre due to varying seed rate are not significant.	(*i*) A spacing trial on *H. sabdariffa* var. *altissima* with different spacings both between and within lines will be conducted to find out suitable spacings for *altissima*. (*ii*) A manurial trial on *H. sabdariffa* with two levels of nitrogen, potash and phosphorus and their combinations will be conducted.

(*vi*) Yield trial with different fibre crops.	*H. sabdariffa* (G.P.) a new selection of the J.A.R.I. has given the highest yield in an yield trial of different fibre crops (two types of each of Sunnhemp, Mesta, Roselle and jute). In a study of the rate of growth it has been found that subsequent to germination Sunnhemp types showed maximum rate of growth up to the 57th day from the date of sowing closely followed by jute. Subsequent to this date the rate of growth is highest in Mesta, Grade 5 all along till the 117th day from the date of sowing.	To be continued at Nilganj farm.
(*vii*) Special fibres.		
1. Sunnhemp.		
(*a*) Study of the growth characteristics.	Agrobotanical characteristics of the different collections of Sunnhemp were studied.	To be continued.
(*b*) Varietal trial.	No significant differences in yield of fibre between 4 varieties were observed in the trial.	To be continued.
2. Linseed.		
(*a*) Agrobotanical studies.	Observation of the morphological characteristics of 20 Flax × Linseed hybrid strains were recorded.	To be continued.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
(*b*) Varietal trial.	In the trial with 13 of the duel purpose strains of I.A.R.I., New Delhi and 4 others evolved at Kanpur and Sabour, the I.A.R.I. strain Flax J.W.S. × Linseed N.C.4 has given significantly higher yield of straw. The poorest yield was recorded in the rust-resistant type RR349.	To be continued.
3. Ramie.	The old plantation at Chinsurah farm was maintained and a good quantity of seed raised.	In the next season fresh Ramie plantation will be done at our farm.
4. Agave.	Some new bulbils of different species of Agave received from Carangal (Hyderabad) were added to the collection.	Fresh collection to be made.
Seed multiplication.	Seeds of different fibre plants under observation were multiplied on a varying but moderate scale both at Chinsurah and Barrackpore farm for distribution.	To be continued.
II. ANATOMICAL & CYTOLOGICAL STUDIES.	The study of the distinguishing features of the fibre bundles and characteristics of the ultimate fibre cells in different fibre plants under observation has been in progress.	To be continued.

III. PHYSIOLOGICAL STUDIES.		
(*a*) Physiology of growth in Mesta & Roselle with reference to the formation of bark and fibre growth and wood during the life-cycle of the plant.	Results were obtained on the following aspects : (1) the relation of moisture content per unit of dry matter, (2) the rate of total growth in terms of dry matter, (3) the comparative rate of formation of wood in relation to the growth of the bark, (4) the comparative rate of pure fibre production in relation to crude bark formation.	To be continued in greater detail.
(*b*) Nutritional investigations on Mesta and Roselle.	The trial in Mesta failed due to heavy virus infection. In case of Roselle it has been observed that F.Y.M. has given significantly the higher yield of fibre than other treatments.	To be continued.
IV. DISEASES.	*Mesta*—Virus attack was recorded. In crop raised from seeds from Uttar Pradesh severe virus infection was recorded. (*ii*) A new fungus was isolated and described causing brown-rot and withering of tops of Mesta plants. (*iii*) *Cercospora hibisci* was found to appear in epidemic form on all types and selections of Mesta.	(*i*) Mode of transmission of Mesta virus will be studied. (*ii*) Inoculation studies and control measures of the new fungus will be tried. (*iii*) Control with colloidal copper and other standard chemicals will be attempted.

Programme of work as sanctioned.	Progress of work in 1951-52	Future programme of work in 1952-53.
	Sunnhemp (*i*) Serious wilt due to *Fusarium vasinfectum* Atk was observed. No resistant type was found. A few selections were made.	(*i*) Selections will be made. (*ii*) Collection of types from wild regions will be made if conditions and funds permit.
	Other fibres :	
	Aloe—*Colletotrichum* sp. was observed on leaves which rotted due to the attack.	Routine observations will be made.
V. PESTS.	*Podagrica apicefulva* has been found to be an important pest for *H. sabdariffa* var *altissima* and *H. cannabinus*.	Investigation on the biology and control of pests of important substitute fibre crops.
	Spiny type of *altissima* has been found to be more resistant to this pest than the spineless one.	

The Star Printing Works, 30, Shibnarain Das Lane, Calcutta—6.